

5.5 Kidney structure and osmoregulation

Name: _____ Class: _____ Date: _____ **Total: 20 marks**

KEY WORDS ultrafiltration • selective reabsorption • loop of Henle
• collecting duct • ADH

Objective

Practise statements 7.18-7.21: kidney structure, ultrafiltration and selective reabsorption, the loop of Henle’s gradient, ADH control of the collecting duct, and urea production in the liver.

1 Key knowledge and worked examples

- **One nephron, four jobs**
 1. **Ultrafiltration** in the glomerulus and Bowman’s capsule: blood pressure (wider afferent arteriole) forces plasma minus cells and proteins through podocytes and the basement membrane.
 2. **Selective reabsorption** in the proximal convoluted tubule: all glucose and amino acids (active transport), most salts, and most water (osmosis following solutes).
 3. **The loop of Henle** : countercurrent multiplication builds a water-potential gradient down the medulla.
 4. **The collecting duct** : ADH decides how much water leaves. **ADH** from the pituitary makes the duct walls permeable (aquaporins) – concentrated urine when you are dehydrated, dilute when you are over-watered.

- **Urea from the liver**

Excess amino acids are **deaminated** (nitrogen to ammonia, then to **urea** via the ornithine cycle); the rest of the carbon skeleton is respired or stored.

- **Worked example: osmosis follows ADH**

Dehydration detected by osmoreceptors in the hypothalamus, ADH released, duct permeable, water reabsorbed to the medullary blood, small volume of concentrated urine. Alcohol suppresses ADH: the opposite. Every ADH answer is this loop read forwards or backwards.

2 Practice

2.1 Name the process by which fluid enters the Bowman’s capsule. [1]

2.2 State two substances reabsorbed in the proximal convoluted tubule. [2]

2.3 Name the hormone that controls water reabsorption in the collecting duct. [1]

3 Exam-style questions

3.1 Explain how the structure of the glomerulus and Bowman’s capsule is adapted for ultrafiltration, referring to three features and the role of each. [5]

3.2 A person drinks 1 dm3 of water. Describe the changes in ADH secretion and in the volume and concentration of their urine, and explain how the kidney achieves the change. [5]

3.3 The table shows the concentration of four substances in blood plasma and in the fluid at two points of the nephron.

Substance	Plasma / g dm-3	Glomerular filtrate / g dm-3	Urine / g dm-3
Glucose	1.0	1.0	0.0
Protein	70	0.0	0.0
Urea	0.3	0.3	9.1
Salts	7.0	7.0	11.6

Explain each difference between the columns, naming the process responsible at each point. [6]