

Exercise walk-through

# 5.5

## Kidney structure and osmoregulation (statements 7.18–7.21)

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Pearson Edexcel · International A-Level · Biology

## Brain regions, scans and chemistry

| Method | Shows              | Basis                        |
|--------|--------------------|------------------------------|
| MRI    | detailed structure | magnetic field + radio waves |
| fMRI   | active regions     | oxygenated blood flow        |
| CT     | fast structure     | rotating X-ray               |
| PET    | metabolism         | radioactive tracer           |

## Recombinant DNA: cut, paste, select

Cut : the same restriction enzyme opens plasmid and gene



Paste : complementary sticky ends sealed by DNA ligase



Transform : heat shock carries plasmids into bacteria



Select : antibiotic marker - only transformants survive

## Check yourself

### Your turn

Why is the human insulin gene made from mRNA before inserting into bacteria?

- ☐ A. bacteria cannot splice introns, and mature mRNA has none
- ☐ B. mRNA is more stable than DNA
- ☐ C. mRNA is double-stranded and easier to cut
- ☐ D. restriction enzymes only cut RNA

## Exercises 2.1·2.3

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

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

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

## Exercises 2.1·2.3

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

**2.1** Ultrafiltration.

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

**2.2** Any two: glucose, amino acids, salts, water.

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

**2.3** ADH (antidiuretic hormone).

## Exercises 3.1·3.2

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**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]

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**3.2** A person drinks 1 dm<sup>3</sup> 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]

## Exercises 3.1·3.2

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**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]

**3.1** The afferent arteriole is wider than the efferent, raising the pressure of blood entering the glomerulus; the capillary walls are fenestrated and the podocytes wrap the capillaries with filtration slits, allowing fluid through; the basement membrane is the selective filter, holding back cells and proteins over a certain size.

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**3.2** Blood water potential rises; osmoreceptors in the hypothalamus detect it and the pituitary reduces ADH secretion; the collecting duct becomes less permeable, so less water is reabsorbed; a larger volume of more dilute urine is produced until water potential returns to normal.

## Exercise 3.3

**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<br>dm <sup>-3</sup> | Glomerular filtrate / g<br>dm <sup>-3</sup> | Urine / g<br>dm <sup>-3</sup> |
|-----------|--------------------------------|---------------------------------------------|-------------------------------|
| 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]

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**3.3** Glucose falls to zero in urine: it is all reabsorbed by active transport in the PCT. Protein absent from the filtrate: too large to pass the basement membrane. Urea concentrated: water is reabsorbed while some urea also diffuses out, but proportionally less than water. Salts concentrated: most reabsorbed, but excess remains as the water leaving exceeds the salts retained.