Physiology Study Questions - Set 14

Renal Physiology

1. Describe the structure and function of the *nephron*. What are the three major processes involved in the formation of urine? Summarize where each of these processes occurs in the nephron.

2. Discuss the process of *glomerular filtration*. What structures make up the filtration membrane? What substances are normally filtered into the nephron? What factors determine the net filtration pressure in the glomerulus and Bowman’s capsule? What is the normal value of glomerular filtration rate (GFR)?

3. Compare the reabsorption of water and solutes in the proximal convoluted tubule with reabsorption in the distal part of the nephron (DCT and collecting duct). What is meant by mass (or bulk) reabsorption? Where does regulated reabsorption of water and electrolytes take place?

4. Recall the epithelial transport processes that are involved in the reabsorption of NaCl, glucose and water in the PCT.

5. Explain how *diabetes mellitus* affects kidney function. Include an explanation of the *renal plasma threshold* for glucose and the phenomenon of *osmotic diuresis*.

6. The *renal clearance* of inulin, a substance which is filtered into the nephron but is neither reabsorbed nor secreted, is equal to the GFR. What can you conclude if the renal clearance of another substance (such as urea) is less than the GFR? What can you conclude if the renal clearance of a substance is greater than the GFR? What is the renal clearance of glucose, normally?

7. Summarize the three main functions of the loop of Henle:
   1) formation of the vertical osmotic gradient in the renal medulla;
   2) formation of dilute fluid in the renal tubule entering the distal nephron;
   3) reabsorption of additional H$_2$O and electrolytes (Na$^+$, K$^+$ and Cl$^-$) from the tubular fluid.

8. What is the *countercurrent multiplier*? What processes and properties of the loop of Henle are essential in the function of the countercurrent multiplier? (Hint: distinguish between the descending limb and the ascending limb in terms of their permeability properties and transport processes.)

9. Discuss the role of the kidneys in the regulation of *plasma osmolarity*. What hormone is primarily involved in the regulation of plasma osmolarity? Where does this hormone act in the kidney, what is its mechanism of action (hint: think aquaporins). How does the action of this hormone help to maintain ECF osmolarity?

10. Discuss Na$^+$ and K$^+$ regulation by the kidneys. What hormone is primarily involved in the renal regulation of Na$^+$ and K$^{++}$? Where are the target cells for this hormone located in the kidney, and what are the specific effects of this hormone? What factors directly and indirectly stimulate the secretion of this hormone?

11. Briefly summarize the renin-angiotensin-aldosterone system. What is the juxtaglomerular apparatus? Explain how the renin-angiotensin-aldosterone system helps to restore normal blood volume and blood pressure when blood pressure falls below normal.

12. Briefly summarize the role of the kidneys in acid-base balance. How (and where) does the enzyme *carbonic anhydrase* act to facilitate renal acid-base processing?