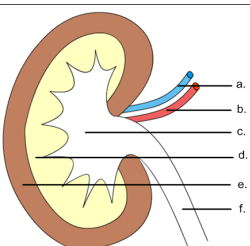


1. Define **excretion**.

- *"The removal from the body of waste products of metabolic processes."*<sup>(1)</sup>

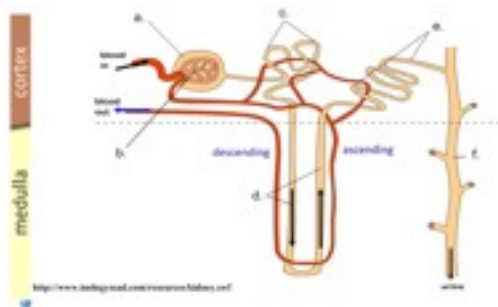
## 2. Label and state the functions of the structures of the kidney.



<http://www.biologymad.com/resources/kidney.swf>

a.	Renal vein
b.	Carries balanced blood away from the kidney.
c.	
d.	
e.	
f.	

The nephron is the functional unit of the kidney.



3. Label and state the structures of the functions of the nephron.

	Structure	Function
a.	Renal capsule	Ultrafiltration of blood.
b.		
c.		
d.		
e.		
f.		

In (overly) simple terms, the kidney works by forcing everything out of the blood and then selectively reabsorbing the components which are desirable. Waste products therefore continue to the pelvis and become part of the urine.

4. Ultrafiltration is the first step, and takes place in the renal capsule.

- a. Distinguish between the *afferent* and *efferent* arterioles.

- 

- b. Identify one component of the renal capsule which is an example of an *extracellular component* in animals.

- 

- c. Explain the process of ultrafiltration.

- 

- 

- 

- 



- d. List three components of the blood which are not pushed into the glomerular filtrate and state the reason why.

- 
- 
- 

5. Selective reabsorption returns valuable molecules to the blood.

- a. State the location of selective reabsorption in the kidney.

- 

- b. List three molecules that are recovered back into the blood by selective reabsorption.

- 

- c. Explain the significance of the following elements of selective reabsorption.

Convolutions of the tubule	
Microvilli	
Mitochondria	
Protein pumps and channels	
Osmosis	

6. A major function of the kidney is to maintain the balance of water in the blood.

- a. Define *osmoregulation*.

- 

- b. List three functions of water in animals.

- 
- 
- 



c. State the location of osmoregulation in the kidney.

- 

d. Distinguish between the descending and ascending parts of the loop of Henle.

- 

e. Explain the role of the loop of Henle in osmoregulation.

Input:		Output:	

f. Explain the role of the collecting duct in osmoregulation.

- 
- 
- 
- 



- g. ADH is a hormone used in negative feedback control of blood water balance.
- i. State the two parts of the brain involved in osmoregulation and their functions.
- -
- ii. Describe the effects of ADH on:

The walls of the collecting duct	
Water uptake into the blood	
Concentration of the urine	

7. Consider this data table:
- a. Calculate the concentration of urea in the urine.

**Patient A**

Composition of plasma, capillary filtrate, and urine (each in g/100 ml of fluid). These are representative values. The values for cells are especially variable, depending on salt and water intake.

Component	Plasma	Capillary Filtrate	Urine	Concentration	% Reabsorbed
Glucose	0.10	0.10	0.0	—	100%
Dis. acid	0.004	0.004	0.05	12.5%	97%
Urea	0.10	0.10	10.0	—	100%
Amino acids	0.10	0.10	10.0	—	100%
Total organic sol.	0.3	0.3	10.0-15.0	10-40%	99.9%
Proteins and other macromolecules	0.1	None	None	—	—

- b. Explain why such a large proportion of urea is removed from the blood.
- c. Explain why no proteins and macromolecules are present in the filtrate or urine.
- d. 100% of glucose is reclaimed. Explain how this occurs.



### Patient B

Composition of plasma, nephric filtrate, and urine (each in g/100 ml of fluid). Values are representative values. The values for urine are especially variable, depending on salt and water intake.

Component	Plasma	Nephric Filtrate	Urine	Concentration	% Reabsorbed
Glucose	0.05	0.05	0.0	-	100%
Glucose	0.004	0.004	0.05	12.5x	97%
Glucose	0.30	0.30	0.15	-	50%
Amino acids	0.05	0.05	Trace	-	100%
Total nitrogenous salts	0.9	0.9	+0.9-3.6	+1-6X	90-99%
Proteins and other macromolecules	0.0	Trace	Trace	-	-

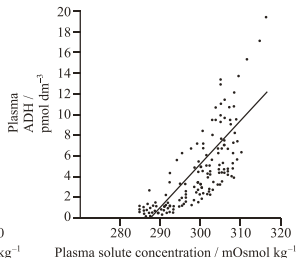
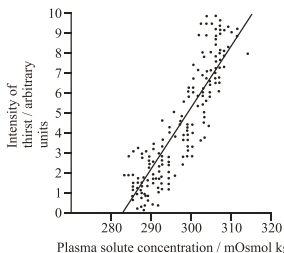
[http://www.ck12.org/Bookshelf/essential-biology/Pages/8\\_Kidney.html](http://www.ck12.org/Bookshelf/essential-biology/Pages/8_Kidney.html)

8. Consider the urinalysis for patient B:
  - a. Calculate the percentage of glucose which is reuptaken to the blood.
    -
  - b. Explain the presence of glucose in the urine of patients with diabetes. You will need to consider two processes in your answer: glucoregulation and osmoregulation.
    - 
    - 
    - 
    - 
    - 
    - 
    -
  - c. Deduce, with a reason, the effective of taking an insulin shot on the urine glucose concentration of a patient with Type I diabetes.
    - 
    -
  - d. Deduce, with a reason, the effective of taking an insulin shot on the urine glucose concentration of a patient with Type II diabetes.
    - 
    -



9. The plasma solute concentration, plasma antidiuretic hormone (ADH) concentration and feelings of thirst were tested in a group of volunteers. These graphs show the relationship between intensity of thirst, plasma ADH concentration and plasma solute concentration.

**(Question taken from the QuestionBank CDRom)**



[Source: adapted from C T Thompson, *et al.*, (1986), *Clinical Science London*, **71**, page 651]

- (a) Identify the plasma ADH concentration at a plasma solute concentration of 300 mOsmol kg<sup>-1</sup> using the line of best fit.

•

(1)

- (b) Compare intensity of thirst and plasma ADH concentration.

•

(1)

- (c) Outline what would happen to plasma solute concentration and ADH concentration if a person were to drink water to satisfy his/her thirst.

•

•

(2)

- (d) State **two** reasons why a person's plasma solute concentration may increase.

•

•

(2)



(Total 6 marks)

10. The proximal convoluted tubule is a part of the nephron (kidney tubule). Its function is selective reabsorption of substances useful to the body.

- (a) Outline how the liquid that flows through the proximal convoluted tubule is produced.

- 
- 

(2)

- (b) (i) Water and salts are selectively reabsorbed by the proximal convoluted tubule. State the name of **one** other substance that is selectively reabsorbed.

- 

(1)

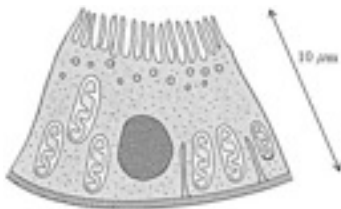
- (ii) State the names of the processes used to reabsorb water and salts.

Water:

salts:

(2)

The drawing below shows the structure of a cell from the wall of the proximal convoluted tubule.



- (c) The actual size of the cell is shown on the diagram. Calculate the linear magnification of the drawing. Show your working.





**Answer**

**(2)**

- (d) Explain how the structure of the proximal convoluted tubule cell, as shown in the diagram, is adapted to carry out selective re-absorption.

- 
- 

**(2)**

**(Total 9 marks)**

