UNIT 11 Excretion

MCQ Section

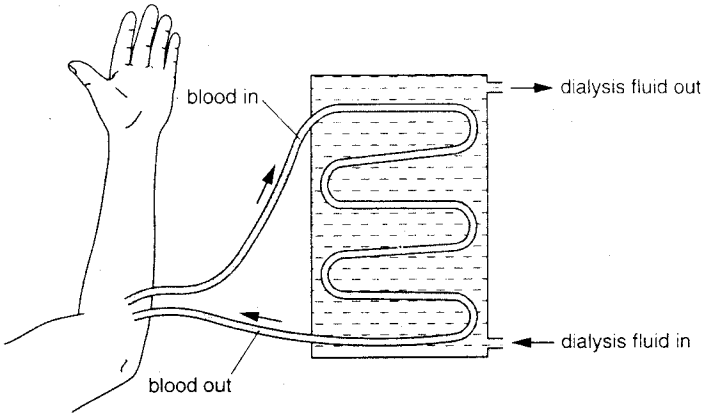
1. Where is urea produced?
   - **A** bladder
   - **B** blood cells
   - **C** kidney
   - **D** liver

   [D01/P1/Q21]

2. Which substance is present at a **lower** concentration in the renal artery than in the renal vein?
   - **A** amino acids
   - **B** carbon dioxide
   - **C** glucose
   - **D** urea

   [J2001/P1/Q16]

3. The diagram shows a kidney machine.



   What must be at the same concentration in the dialysis fluid and in the blood?
   - **A** glucose
   - **B** salt
   - **C** urea
   - **D** water

   [J2001/P1/Q21]

4. The four structures listed are part of the human excretory system.
   1. bladder
   2. kidney
   3. ureter
   4. urethra

   In which order does a molecule of urea pass through these structures?

	first → last			
A	1	2	3	4
B	1	4	3	2
C	2	1	3	4
D	2	3	1	4

   [D2000/P1/Q20]

5. Where is urea made in the human body?
   - **A** bladder
   - **B** gall bladder
   - **C** kidneys
   - **D** liver

   [D2000/P1/Q21]

6. Which of the following is an example of excretion?
   - **A** release of insulin from the pancreas
   - **B** release of saliva from the salivary glands
   - **C** removal of carbon dioxide from the lungs
   - **D** removal of faeces from the alimentary canal

   [J00/P1/Q19]

1. C The renal artery carries blood containing a high concentration of urea into the kidney. Urea is removed by ultrafiltration process in the kidney tubule and excreted by the kidney as urine.

2. B The renal artery carries oxygenated blood, dissolved nutrients and metabolic wastes into the kidney. The oxygen and nutrients are required by the kidney cells for respiration. Urea is excreted by the kidney.

3. A Glucose must be at the same concentration to ensure that there is no diffusion gradient for glucose. This is to prevent loss of glucose from the blood to the dialysis fluid by diffusion.

4. D Urea is filtered from blood in the glomeruli of the kidney tubules and carried together with other waste in urine to the bladder by the ureter. The urine is stored temporary in the bladder until it is removed from the body through the urethra.

5. D Deamination of excess amino acids in the liver produces urea which is excreted by the kidney.

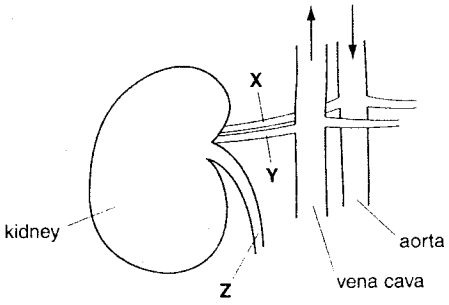
6. C Excretion is the removal of harmful waste products of metabolic reactions in the body. Both insulin and saliva are secretions produced by glands. The removal of faeces (undigested matter) is called egestion.

7. In a kidney machine, which of the following passes from the blood to the dialysis fluid?

A glucose
B plasma protein
C red blood cells
D urea

[J00/P1/Q20]

8. The diagram shows the structures associated with a human kidney.



What are the relative concentrations of urea in **X**, **Y** and **Z**?

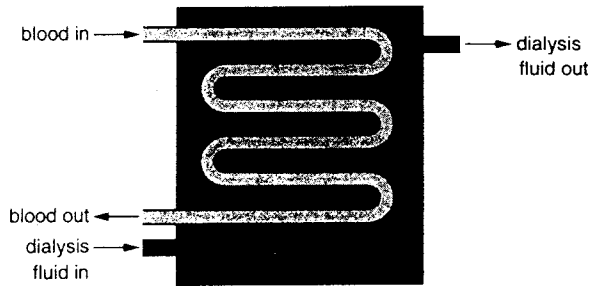
	X	Y	Z
A	high	low	high
B	high	low	low
C	low	high	high
D	low	high	low

[D99/P1/Q21]

9. The diagram represents a dialysis machine (kidney machine).

Which substances in the dialysis fluid should be at a lower concentration than in the blood?

A amino acids and glucose
B glucose and salts
C glucose and urea
D salts and urea



[J99/P1/Q20]

10. Samples of blood from the renal artery and the renal vein are analysed.

What does the blood in the renal artery contain, in comparison with the blood in the renal vein?

A less carbon dioxide and more urea
B more carbon dioxide and less urea
C less oxygen and more urea
D more oxygen and less urea

[J99/P1/Q21]

11. Which substance is present at a **lower** concentration in the renal artery than in the renal vein?

A amino acids **C** glucose
B carbon dioxide **D** urea

[D98/P1/Q14]

12. Which substances are found in the glomerular filtrate in the kidneys of a mammal?

	glucose	*protein*	*salts*
A	✓	✓	✗
B	✓	✗	✓
C	✗	✓	✓
D	✗	✗	✓

key ✓ = present ✗ = absent

[D98/P1/Q20]

MCQ Answe

7. D The urea wh is at a higher concentra in blood diffuses into dialysis fluid. There is concentration gradient glucose as the dialysis f contains approximately same concentration of cose as in blood.

8. A Blood vesse is the renal artery. Bl vessel Y is the renal and tubule Z is the ure

9. D The dialy fluid contains a regula amount of dissolved s glucose and amino a with a composition sin to the blood plasma (v out urea). A concentra gradient is set up when patient's blood, which a higher concentratio urea and mineral sa flows through the tubu Urea and excess min salts diffuse from patie blood across the selecti permeable walls of coiled tubule into the d sis fluid. The dialysis is changed regularl remove the waste s stances and to maintain diffusion gradient betw the patient's blood and dialysis fluid.

10. A The renal artery supplies oxygenated blood a higher concentration of urea and salts to the kidney. Tis respiration, ultrafiltration and selective reabsorption proces in the kidney results in the formation of carbon dioxide the removal of urea and excess mineral salts which excreted in urine. The deoxygenated blood in the renal has the least urea as almost all urea are removed in the kid tubules.

11. B The renal artery carries blood which suppli high concentration of oxygen (therefore, a low concentra of carbon dioxide) and a high concentration of nutrient tissue respiration in the kidney cells. It also carries a concentration of urea to the kidney to be excreted. The r vein carries deoxygenated blood away from the kidne wards the heart. The blood in the renal vein has the l urea as it is removed in the kidney tubules by ultra-filtra and excreted in urine.

13. Which blood vessel carries blood with the **lowest** concentration of urea?

A hepatic portal vein
B pulmonary vein
C renal vein
D vena cava

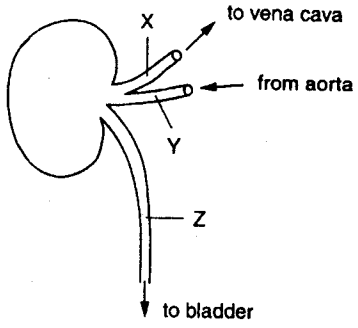
[J98/P1/Q4]

14. From which of the following is urea formed?

A fat
B glycerol
C protein
D starch

[J98/P1/Q20]

15. The diagram shows the kidney and three tubes associated with it.



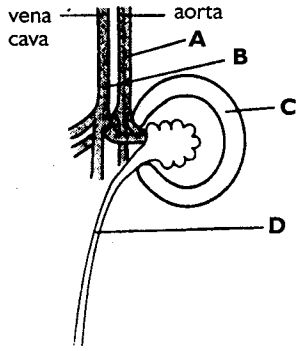
Where will urea be found?

A Z only
B X and Z only
C X and Y only
D X, Y and Z

[D97/P1/Q21]

16. The diagram shows part of the human urinary system.

Where is urea **most** concentrated?



[J97/P1/Q21]

17. Which substance is present in the blood but **not** in the urine of a healthy person?

A glucose
B salts
C urea
D water

[D96/P1/Q19]

18. About 170 litres of fluid are filtered by the kidneys every day. Only 1.5 litres are excreted in urine.

What happens to the remaining 168.5 litres?

A It becomes tissue fluid.
B It is stored in the bladder.
C It is reabsorbed into the blood.
D It is lost as sweat.

[J96/P1/Q18]

19. Urea is produced in one organ, filtered from the blood by a second organ and stored inside a third organ before being expelled from the body.

Which organs carry out these functions?

	production	*filtration*	*storage*
A	kidney	bladder	liver
B	kidney	liver	bladder
C	liver	bladder	kidney
D	liver	kidney	bladder

[D95/P1/Q18]

20. The structures listed below are parts of the human excretory system.

1 bladder
2 kidney
3 ureter
4 urethra

In which order does a molecule of urea pass through these structures?

	first ⟶			*last*
A	1	2	3	4
B	1	4	3	2
C	2	1	3	4
D	2	3	1	4

[D94/P1/Q19]

T h i n k i n G P r o c e s S

MCQ Answers

12. B Blood proteins are too large to pass through the semipermeable membrane of the glomerulus in the Bowman's capsule even under high pressure filtration.

13. C The blood in the renal vein has the least urea as it is removed in the kidney tubules by ultra-filtration and excreted in urine. The blood in the hepatic portal vein has the highest amount of soluble food substances e.g. amino acids, glucose. The vena cava has a high concentration of carbon dioxide whereas the pulmonary vein has the highest concentration of oxygen.

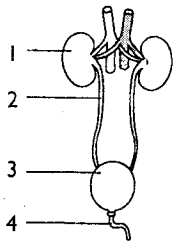
14. C Deamination of excess amino acids in the liver produces urea which is excreted by the kidney.

15. D Note that the question did not mention anything about the concentration of the urea. All three vessels contain urea but in different concentrations levels. The blood plasma from the renal artery entering kidney contains urea produced by the deamination of excess amino acids in the liver. The concentration of urea is highest (about 2%) in urine found in Z and lowest in the blood leaving the kidney (about 0.03%).

16. D Urine which contains the highest concentration of urea is carried to the urinary bladder for storage via the ureter.

17. A The kidney of a healthy person should selectively reabsorb glucose so that none is lost in the urine.

21. The diagram shows part of the excretory system of a mammal.

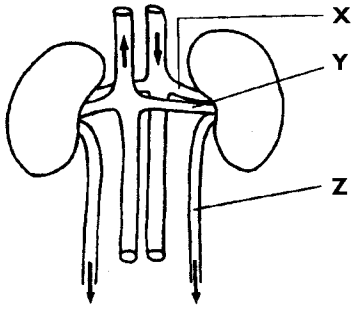


What are the numbered structures?

	1	2	3	4
A	bladder	ureter	kidney	urethra
B	bladder	urethra	kidney	ureter
C	kidney	ureter	bladder	urethra
D	kidney	urethra	bladder	ureter

[J94/P1/Q18]

22. The diagram shows part of the urinary system of a mammal.

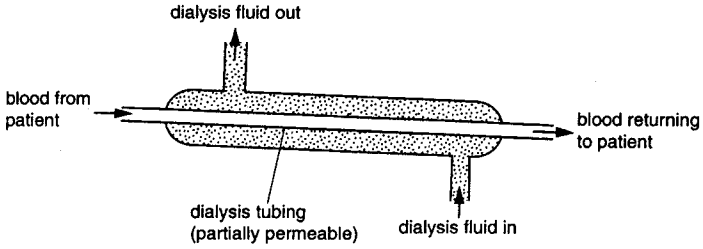


What are the structures labelled **X**, **Y** and **Z**?

	X	Y	Z
A	artery	vein	ureter
B	artery	vein	urethra
C	artery	ureter	urethra
D	vein	artery	ureter
E	vein	ureter	urethra

[D93/P1/Q18]

23. The diagram represents the process of dialysis in a kidney machine.



Which substance would **not** be present in the dialysis fluid flowing in?

A glucose **C** urea
B salt **D** water

[J02/P1/Q20]

24. What happens to blood as it passes through a kidney machine?

A Carbon dioxide is removed.
B Glucose is added.
C Oxygen is added.
D Urea is removed.

[D02/P1/Q20]

25. Some of the structures in the excretory system are listed.

1 bladder
2 ureter
3 urethra

In which order does a molecule of urea pass through these structures?

	first ⟶ last		
A	1	2	3
B	1	3	2
C	2	1	3
D	3	1	2

[D03/P1/Q19]

26. How is a working kidney dialysis machine similar to a healthy kidney?

A It takes sugar molecules out of the blood.
B It regulates the concentration of the blood.
C It deaminates amino acids to urea.
D It removes large molecules from the blood.

[D03/P1/Q20]

18. C Fact.

19. D Fact.

20. D Urine is formed in the kidneys. It then passes through the ureter into the bladder, before being discharged via the urethra.

21. C Fact.

22. A The renal vein (**Y**) carries blood away from the kidney and the renal artery (**X**) carries blood towards the kidney. **Z** is the ureter.

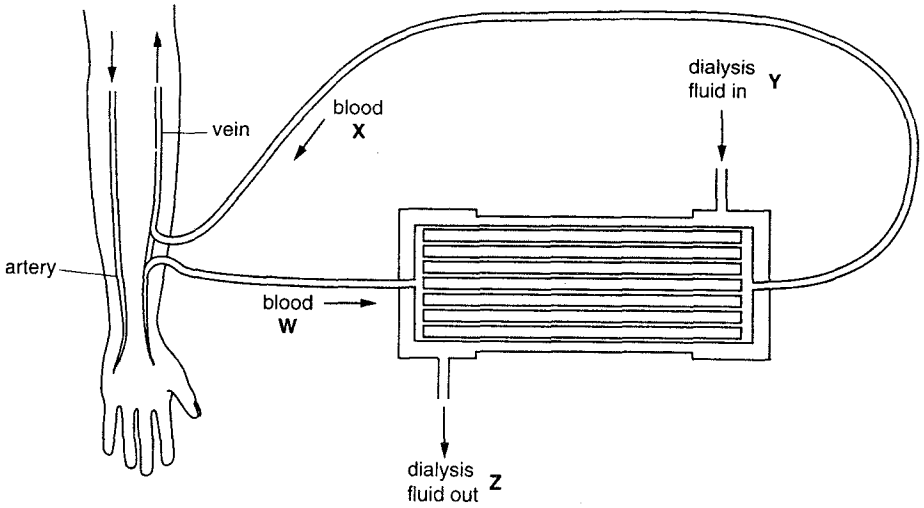
23. C The sterile dialysis fluid is similar to blood plasma in that it contains a carefully regulated amount of dissolved salts and sugars but without any nitrogenous wastes.

24. D In the kidney machine, a concentration gradient is maintained between the dialysis fluid and blood plasma. Urea from the blood diffuses from a higher concentration in the blood plasma into the dialysis fluid. The dialysis fluid has a glucose concentration similar to the blood plasma to reduce the lost of glucose by diffusion to a minimum.

25. C Urine produced by the kidney tubules are carried to the bladder by the ureter. The urine is stored temporary in the bladder until it is removed from the body through the urethra.

26. B A concentration gradient is set up when the patient's blood, which has a higher concentration of urea and mineral salts, and the dialysis fluid surrounding the tubules. Urea and excess mineral salts diffuse from patient's blood across the selectively permeable walls of the tubules into the dialysis fluid.

27. The diagram shows the flow of blood and dialysis fluid through a kidney machine.



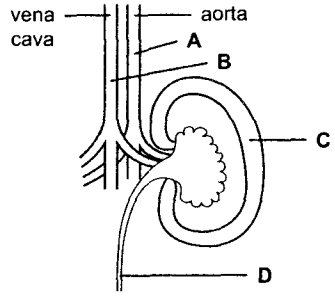
Where would the concentration of urea be highest?

A **W** and **X** **C** **Y** and **Z**

B **X** and **Y** **D** **Z** and **W**

[J03/P1/Q21]

28. The diagram shows part of the human urinary system. Where is urea **most** concentrated?



[D04/P1/Q18]

29. What is an example of excretion?

A release of adrenalin from the adrenal glands

B release of sweat from the sweat glands

C removal of carbon dioxide from the lungs

D removal of faeces from the alimentary canal

[D04/P1/Q19]

MCQ Answers

27. D The blood plasma **W** from the artery entering kidney machine contains the highest concentration of urea. The blood **X** has the least urea as it is removed in the coiled tubules by ultra-filtration and excreted in the dialysis fluid **Z**.

28. D The renal artery carries blood containing a high concentration of urea into the kidney. Urea is removed by ultrafiltration process in the kidney tubule and excreted by the kidney as urine. Urea is carried together with other waste in urine to the bladder by the ureter.

29. D Excretion is the removal of harmful waste products of metabolic reactions and toxic materials from the body of an organism. Carbon dioxide is a metabolic waste product of aerobic respiration in all living tissues which is removed from the lungs during expiration.

UNIT 11 Excretion

THEORY Section

Question 1

Fig. 5.1 shows a longitudinal section through the abdomen of a person (not all abdominal organs are shown) and some detail of the membrane, **R**, that lines the abdominal cavity.

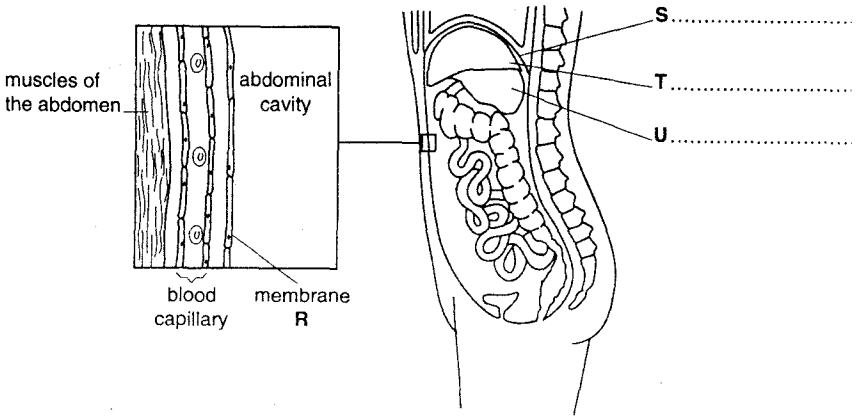


Fig. 5.1

(a) On Fig. 5.1, name the structures labelled **S**, **T** and **U**. [3]

(b) Fig. 5.2 shows a method of dialysis used by patients whose kidneys have ceased to function.

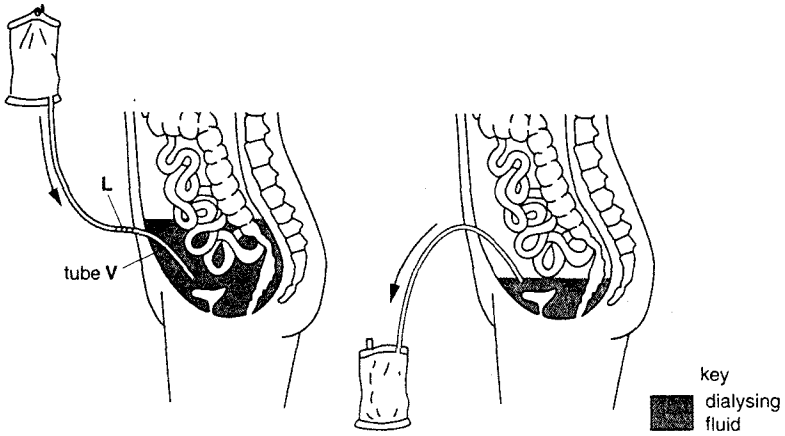


Fig. 5.2

While the fluid is in the abdominal cavity, chemicals can pass into it from the blood in the capillaries, through membrane **R**.

To prevent useful chemicals leaving the patient's blood, certain chemicals may be added to the dialysing fluid before it enters the abdominal cavity.

(i) Name two chemicals that **will** pass from the blood into the dialysing fluid. [2]

(ii) State the process by which these chemicals enter the dialysing fluid. [1]

(iii) Suggest the identity of **one** of the chemicals added to the dialysing fluid and explain how its presence prevents that chemical from leaving the blood.

name of chemical .....

explanation ..... [2]

[J01/P2/Q5]

Solution

(a) Structure **S** – diaphragm
Structure **T** – Liver
Structure **U** – stomach

(b) (i) 1. Urea
2. Mineral salts

(ii) Diffusion

(iii) *Name of chemical* – Glucose

Explanation – To prevent the loss of glucose from the blood during dialysis. Loss of glucose reduces the glucose available for tissue respiration causing patient to feel tired due to lesser energy produced by the body.

COMMENT on **ANSWER**

"(b) ii) Only solute molecules from a region of higher concentration in blood move out of blood capillary walls into a region of lower concentration in the dialysing fluid.

iii) The dialysing fluid contains a carefully regulated amount of dissolved salts and glucose with a composition similar to the blood plasma (without the nitrogenous waste.) Since there is no concentration difference, no net movement of glucose from the blood to the dialysing fluid will occur."

Question 2

(a) Name the waste products of metabolism and, for each waste product, state which organ removes it from the blood. [3]

(b) Outline how a kidney dialysis machine works. [7]

(c) Why is the removal of faeces from the alimentary canal **not** considered to be excretion? [2]

[J97/P2/Q7]

COMMENT on **QUESTION**

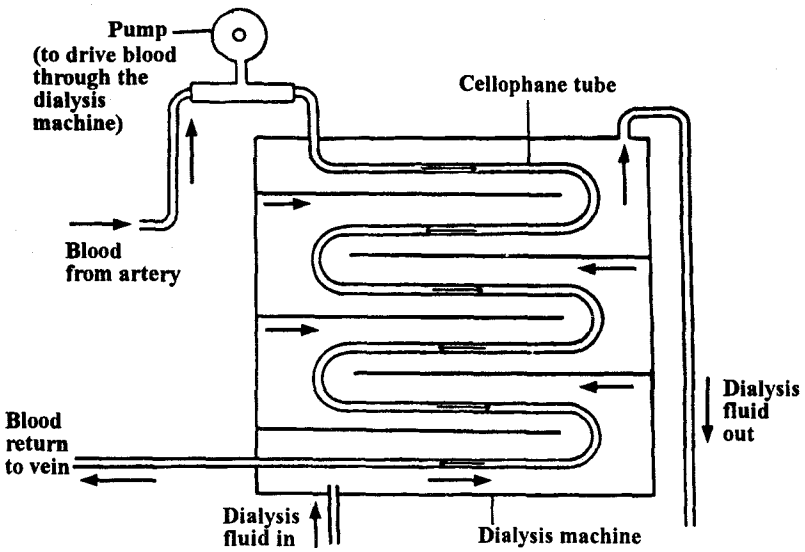
"(c) What is the difference between excretion and defaecation? Another term used for removal of undigested food and other gut contents as faeces is egestion."

Solution

(a) The main metabolic waste products are carbon dioxide and water from aerobic respiration in cells and urea and nitrogeneous substances from breakdown of proteins and amino acids in liver.

Metabolic waste products	**Excretory Organ**
Carbon dioxide and water	Lungs
Urea and nitrogeneous substances, water	Kidneys
Urea and nitrogeneous substances	Liver
Urea and water	Skin

(b) A diagrammatic representation of a kidney dialysis machine is shown below:



In the dialysis unit of the kidney dialysis machine, the patient's blood in the coiled cellophane tubule is bathed in a sterile dialysis fluid which collects the waste molecules. The cellophane tubule acts as a semi-permeable membrane which allows small molecules of substances to diffuse through and prevents the passage of blood cells and large proteins. The dialysis fluid contains a carefully regulated amount of dissolved salts and glucose with a composition similar to the blood plasma (without nitrogeneous waste).

A concentration gradient is set up and nitrogeneous wastes, excess mineral salts and other toxins diffuse from patients blood across the cellophane into the dialysis fluid. The dialysis fluid is changed regularly to remove the waste substances and to maintain the diffusion gradient between the patient's blood and the dialysis fluid. The patient's blood is led from an artery in his forearm through the coiled cellophane tube in the dialysis machine and then re-enters the body via a vein in the same arm. The blood is prevented from clotting in the machine by addition of an anti-clotting chemical. The temperature of the dialysis fluid is maintained at body temperature.

(c) Excretion is the removal of metabolic waste products which are formed in chemical reactions in the cells.

Removal of faeces (defaecation) is the removal of undigested or indigestible substances from the alimentary canal through the anus. Since faecal matter is not produced by metabolism, removal of faeces cannot be considered as excretion.

Question 3

Explain how the blood system carries a **named** waste product from the liver to the kidneys. [4]

[D95/P2/Q10b]

Solution

Urea is produced in the liver during the deamination of amino acids. It is carried in the blood as a dissolved substance in the plasma. It is carried in the renal artery to the kidney.

COMMENT on **ANSWER**

"(b) The exchange of a substance that occurs when the blood and dialysis fluid are in counterflow to each other. The dialysis unit causes the blood to run along one side of a cellophane membrane and the dialysis fluid to run in the opposite direction along the other side of the membrane to maintain the concentration gradient between the patient's blood and the dialysis fluid.

To prevent the lost of glucose from the blood during dialysis the concentration of glucose in the dialysis fluid is maintained at the same as that in patient's blood. Since there is no concentration gradient, no net movement of glucose from the blood will occur.

(c) The difference lies in the source and the type of substances removed from the body by each process. Metabolic wastes are formed as a by-product in metabolic reactions such as carbon dioxide from respiration and urea from deamination of amino acids in liver. "

Question 4

Fig. 2 shows a diagram of a kidney and associated structures. The tables list the percentages of certain components found within structures **B** and **C**.

in structure **B**	
Component	*Concentration/%*
urea	0.03
glucose	0.10
amino acids	0.05
salts	0.72
proteins	8.00

in structure **C**	
Component	*Concentration/%*
urea	2.00
glucose	0.00
amino acids	0.00
salts	1.50
proteins	0.00

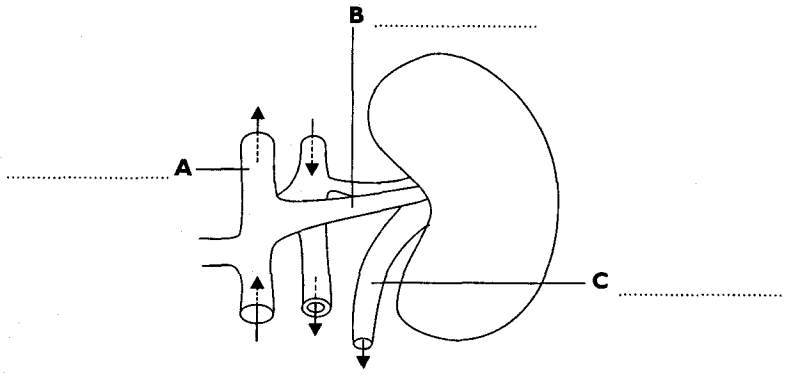


Fig. 2

(a) On the diagram, label structures **A**, **B** and **C**. [2]

(b) Which chamber of the heart first receives the contents of structure **A**? [1]

(c) Using **only** the information in the tables in Fig. 2, deduce the functions of the kidney. [2]

(d) Explain how the proportions of the components present in **C** would change

(i) after eating meat;

(ii) if a person suffering from diabetes had not taken enough insulin. [6]

[D94/P2/Q2]

COMMENT on QUESTION

"(c) Answer must be based only on what is given in the 2 tables.

(d) Describe the change in the urine constitution under the 2 conditions."

Solution

(a) **A** Inferior Vena Cava

B Renal Vein

C Ureter

(b) Right atrium

(c) The kidney plays an important role in removing urea and excess salts from the body.

COMMENT on ANSWER

"(a) B is the renal vein because it is carrying blood away from the kidney (see arrow for direction of blood flow).

(b) The inferior vena cava brings blood into the right atrium of the heart.

(c) Examining the table shows that only urea and salts are found in high concentration in the ureter. These are for excretion from the body."

COMMON ERROR

"(c) Students tend to list functions of kidney which are not shown in the tables."

(d) (i) The concentration of urea in the urine would increase. This is because meat contains a large proportion of proteins, which are broken down to amino acids in the small intestine. Excess amino acids are deaminated in the liver and converted to ammonia and then to urea. The urea is transported to the kidneys to be removed in the urine.

(ii) The concentration of glucose would increase. Without sufficient insulin, glucose cannot be converted to glycogen for storage, or utilised by the tissue cells in tissue respiration. The blood glucose concentration rises and some glucose is subsequently lost in the urine.

Question 5

(a) Define the term *excretion.* [2]

(b) What part is played in excretion by (i) the lungs, and (ii) the kidneys? [5]

(c) Explain how a kidney machine helps a person whose kidneys have ceased to function. [5]

[J94/P2/Q8]

COMMENT on QUESTION

"(b) Name the waste products excreted by each of the organs and the means by which this is done.

(c) Describe the process of dialysis."

Solution

(a) Excretion is the process by which metabolic waste products (e.g. urea, carbon dioxide and water) are removed from the body of an organism.

(b) (i) The lungs excrete carbon dioxide and water vapour from the body in the expired air.

(ii) The kidneys excrete excess mineral salts, nitrogenous waste products (urea, creatinine and uric acid) and excess water in the urine.

(c) Blood is drawn from an artery in the patient's arm and is allowed to flow through the tubing in the dialysis machine. The tubing, which has selectively permeable walls, is bathed in a specially controlled dialysis fluid. Urea and other waste products diffuse out of the tubings into the dialysis fluid. The filtered blood is then returned to a vein in the patient's arm. In this way, the dialysis machine acts as a substitute kidney and helps remove waste products which would otherwise have accumulated in the body.

COMMENT on ANSWER

"(a) From definition.

(c) The kidney machine, or dialysis machine, takes over the task of the kidney in removing urea and other waste products which are normally excreted in the urine."

Question 6

Describe how the following help to maintain a constant internal environment.

(a) the skin [7]

(b) the kidneys [3]

[D03/P2/Q8 or]

COMMENT on **QUESTION**

"(a) Homeostasis is defined as "the maintenance of a constant internal environment" in a living organism."

Solution

(a) Changes in the body temperature is kept within narrow limits by the process of homeostasis. The skin helps to regulate blood temperature and the regulatory processes involve a negative feedback mechanism. An increase in blood temperature is detected by the hypothalamus of the brain and feedback this information to the sensory organs in the central nervous system. This cause a series of corrective mechanisms in the body to produce the opposite effect i.e. to reduce the temperature and return it to the normal body temperature of 37 °C. The adjustments initiated in response to an increase in body temperature include:

1) An increase production of sweat by sweat glands and evaporation of sweat removes heat from the skin.

2) Vasodilation of arterioles and blood capillaries near surface of the skin so that more heat from blood can be loss to the surroundings by radiation.

(b) Besides getting rid of urea, the kidneys also help to maintain the level of water and salts in the blood. Depending on the diet, there is likely to be more than the body needs, so the kidneys remove whatever is in excess. In order to keep the correct salt/water balance in the body, the composition of the urine is varied. Blood passing through the hypothalamus of the brain is constantly monitored; if its water content falls, then a hormone Anti-Diuretic Hormone is released into the blood (from the pituitary gland, near to the hypothalamus). The ADH passes via the bloodstream to the kidneys, where it causes more water to be reabsorbed from the nephrons. As a result, more water enters the blood, so that its blood concentration is kept constant, and the urine becomes more concentrated.

COMMENT on **ANSWER**

"(b) Each kidney contains about a million very fine tubules called nephrons, which produce urine by 2 main stages: Ultrafiltration in the glomerulus of the Bowman's capsule and selective reabsorption of water and mineral salts in the Loop of Henle of the nephron."