

Excretion (The Kidney)

1. The kidneys of a healthy individual filter $178 \text{ dm}^3 \text{ day}^{-1}$ of fluid from the glomeruli into the renal capsules. However, only $1.5 \text{ dm}^3 \text{ day}^{-1}$ of urine is produced.

What percentage of the filtrate is reabsorbed back into the blood?

- A 176.5
- B 0.8
- C 11.8
- D 99.2

Your answer

[1]

2. Patients with kidney failure can be treated in different ways.

Which of the following statements describes a feature of peritoneal dialysis?

- 1 Urea and mineral ions pass into the tissue fluid.
- 2 Blood is passed over an artificial membrane to remove toxins.
- 3 The patient receives immunosuppressant medication.

- A 1, 2 and 3
- B Only 1 and 2
- C Only 2 and 3
- D Only 1

Your answer

[1]

3. The hormone hCG can be detected in urine using pregnancy tests.

Which of the following properties of the hormone hCG allows it to be detected in urine?

- A hCG is a polar molecule
- B hCG has a molecular mass of less than 69,000
- C hCG is a polypeptide
- D hCG binds to cells using glycoproteins

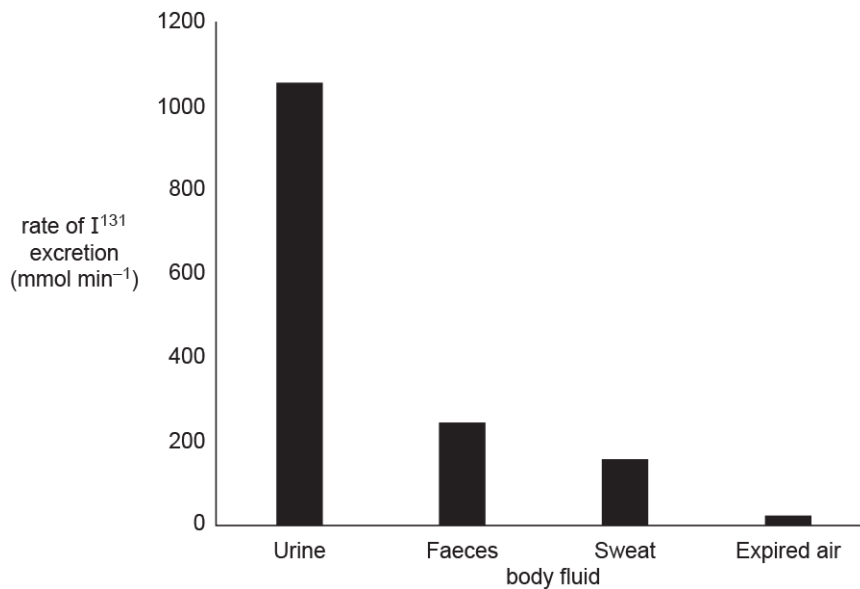
Your answer

[1]

4. One treatment for thyroid cancer is radioactive iodine. The radioisotope I^{131} is used.

The thyroid gland absorbs any iodine that enters the body, so the radioactive isotope kills the cancerous cells in the thyroid gland. The I^{131} is then excreted from the body.

Different body fluids excrete different proportions of I^{131} , as shown in the following graph.



Which of the following, **A** to **D**, correctly explains the different proportions of I^{131} in each body fluid?

- A** I^{131} is very soluble in water.
- B** I^{131} is able to cross capillary walls.
- C** The kidneys are more efficient at excreting I^{131} than the lungs.
- D** The thyroid gland is well supplied with blood.

Your answer

[1]

5. Damage to the hypothalamus results in lower water potential of the blood. Which of the following, A to D, explains these observations?

- A ADH release increases the water potential of blood.
- B Mineralocorticoids affect cells in the loop of Henle.
- C Fewer water channels are inserted into the cell surface membranes of the collecting duct.
- D The anterior pituitary releases hormones into the blood.

Your answer

[1]

6(a). The kidney is one of the organs of excretion in vertebrate animals.

Fig. 2.1 shows a light micrograph of a section through a kidney cortex.

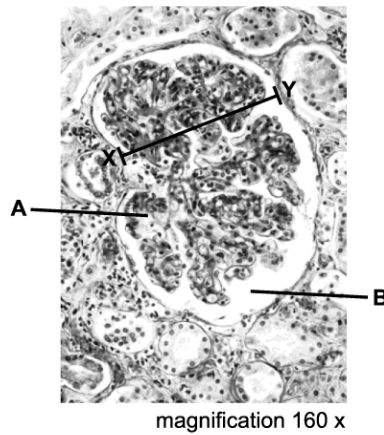


Fig. 2.1

i. Name the parts of the kidney labelled **A** and **B**.

A

B

[2]

ii. Calculate the length of the line labelled **X** to **Y**.

Give your answer in micrometres (μm) to **two** significant figures.

Answer = μm [2]

(b). Sodium ions and glucose are both reabsorbed into the blood from proximal convoluted tubules (PCTs) in the kidney.

- i. A student designed an experiment to investigate the effect of temperature on the rate of glucose diffusion through dialysis tubing.

State **two** factors that would need to be controlled in this experiment.

1

2

[2]

- ii. Describe the structural difference between alpha and beta glucose molecules.

[1]

- iii. Sulthiame is a drug that inhibits the enzyme carbonic anhydrase.

Fig. 2.2 shows the role of carbonic anhydrase in the PCT of the kidney.

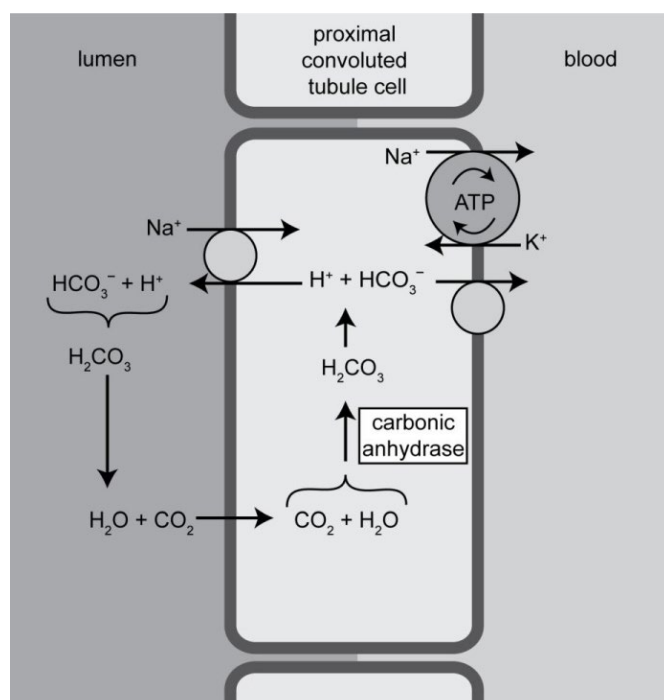


Fig. 2.2

7. Fig. 19.3 is a light microscope image of kidney tubule cells.

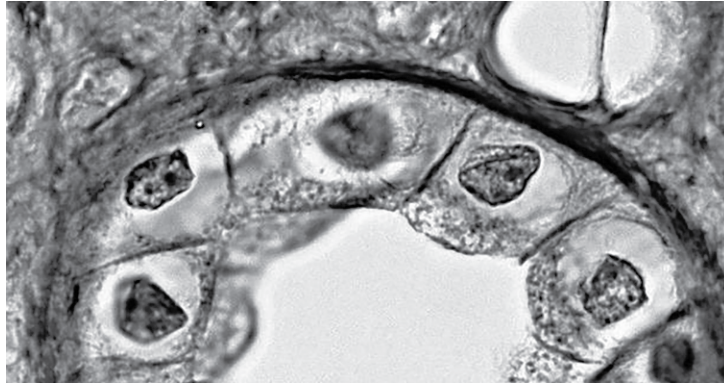


Fig. 19.3

i. State **three** structures within the tubule cells that are **not** visible in this image.

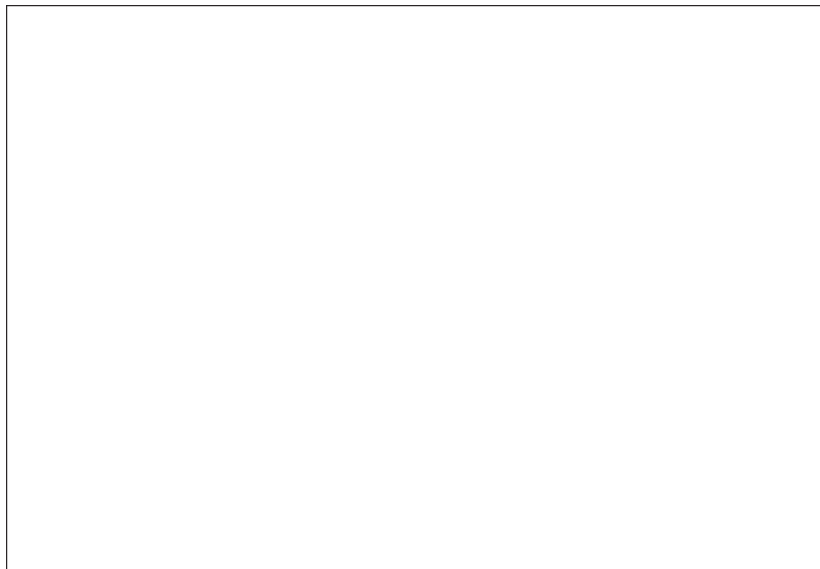
1

2

3

[3]

ii. Draw **one** of the cells from Fig. 19.3 in the space below.
Label your diagram to show any visible features.



[4]

8(a). Fig. 22.1, below and **on the insert**, is a cross section of part of the cortex of a mammalian kidney.

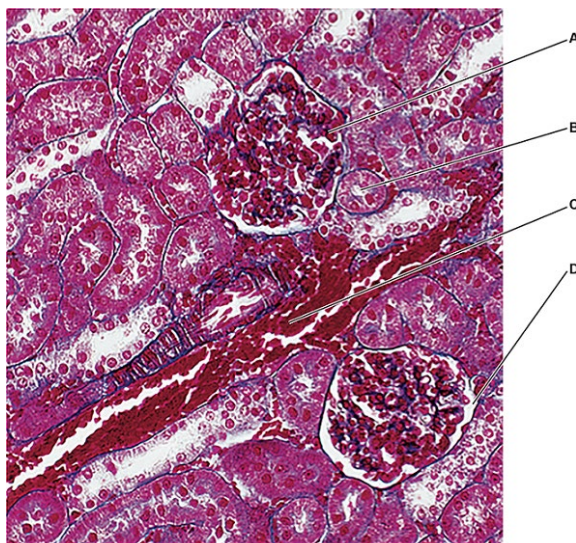


Fig. 22.1

i. Which letter identifies the region with the highest hydrostatic pressure?

----- [1]

ii. Which **two** letters identify regions that **do not** contain plasma proteins?

----- [1]

(b). Studies of the cell surface membranes of the **distal** convoluted tubule have provided the following evidence:

- Sodium-potassium pumps:
 - move potassium ions from the blood to the tubule fluid
 - move sodium ions from the tubule fluid to the blood
 - use ATP in these processes.
- Sodium-calcium co-transport proteins:
 - move calcium ions from the tubule fluid to the blood
 - move sodium ions into the tubule fluid
 - use the electrochemical gradient of sodium ions to drive this process.

i. Using this information and your own knowledge, compare the processes occurring in the **proximal** and **distal** convoluted tubules.

 ----- [3]

(b). A person's glomerular filtration rate (GFR) provides an indication of the health of their kidneys. The GFR is a measure of the volume of blood that can be filtered by the kidneys every minute.

GFR can be estimated by monitoring the blood concentration of creatinine, which is a breakdown product of creatine phosphate in muscles.

- i. Suggest **two** characteristics of a patient that must be taken into account when using this GFR measurement to diagnose kidney damage.

Explain why each characteristic must be considered.

1.....

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2.....

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[4]

- ii. If kidney damage is suspected, the patient's urine is likely to be tested for the protein albumin.

Explain why the presence of albumin in the urine indicates kidney damage.

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[1]

10(a). A student dissected a kidney. Fig. 1.1 shows one half of the dissected kidney.

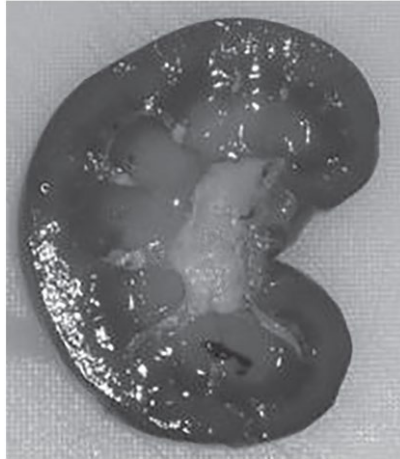
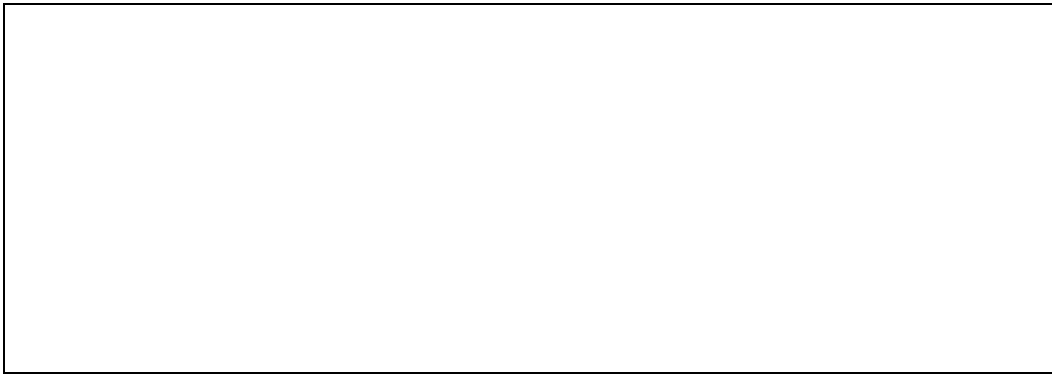


Fig. 1.1

Draw a simple diagram of the kidney in Fig. 1.1 in the space below.

On your diagram, label the pelvis, medulla and cortex.



[2]

(b). A photomicrograph of a stained section of kidney tissue is shown in Fig. 1.2.

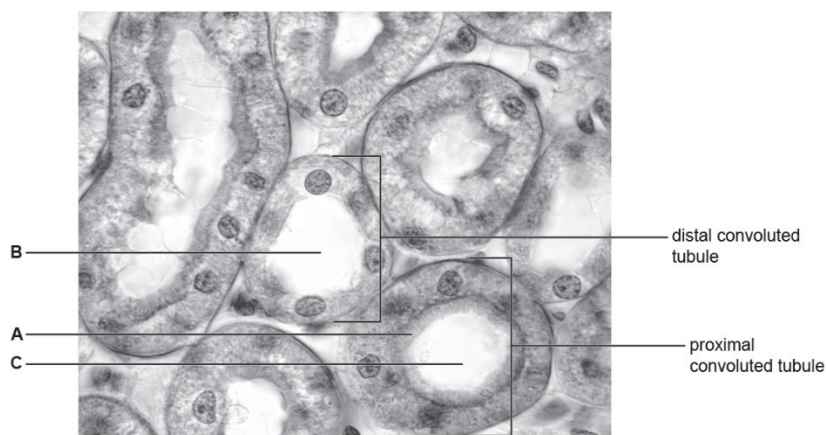


Fig. 1.2

i. State one function of the distal convoluted tubule.

[1]

ii. Describe the function of the structures labelled **A** in Fig. 1.2.

[1]

iii. Suggest which lumen, **B** or **C**, has the highest concentration of urea. Explain your answer.

[1]

11(a). Fig. 19.1 is a diagram of a nephron from a mammalian kidney.

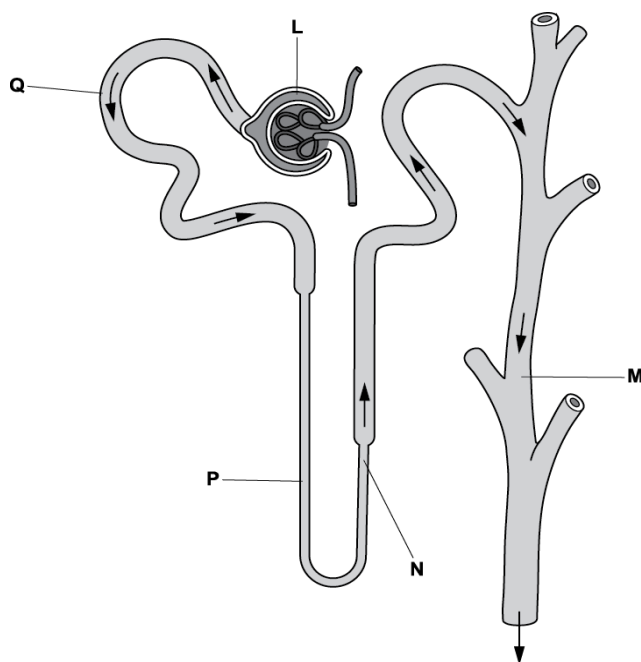


Fig. 19.1

Which letter or letters label areas of the nephron which are directly affected by ADH?

----- [1]

(b). A scientist investigated the effect of different types of food on the rate of urine production in adults.

- The subjects were given one food type for a period of three hours.
- After this, their rate of urine production was measured for the following three hours.
- Over the 6 hours of the procedure they consumed a controlled volume of water.

Fig. 19.2 is a graph of the results.

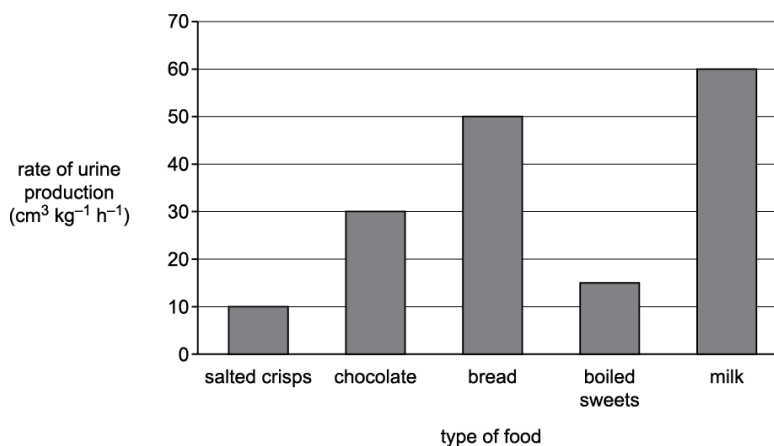


Fig. 19.2

(b). Diuretics are drugs that decrease the reabsorption of water into the blood from the kidney.

Diuretics can change the concentration of ions and other molecules in the blood.

Some diuretics are used to treat high blood pressure.

The table below lists three different diuretics, **X**, **Y** and **Z**, and some of their effects in the body.

	Without a diuretic	With a diuretic		
		X	Y	Z
Rate of urine production (ml min ⁻¹)	1	3	13	8
Blood chloride ion concentration (mmol dm ⁻³)	60	15	150	150
Blood potassium ion concentration (mmol dm ⁻³)	15	60	12	25
Blood glucose concentration (mmol dm ⁻³)	6	6	9	8

- i. Suggest which of the diuretics, **X**, **Y** or **Z**, would be the most effective at reducing a person's blood pressure. Explain your choice.

Diuretic

Explanation

[1]

- ii. Suggest which of the diuretics, **X**, **Y** or **Z**, would be the most appropriate for use by a person with type II diabetes. Explain your choice.

Diuretic

Explanation

[1]

13(a).

- i. Another result of cycasin poisoning can be kidney damage. Increasing numbers of pet owners in the USA and Asia are using dialysis to treat animals with damaged kidneys.

There are two types of dialysis: peritoneal dialysis and haemodialysis. Both of these dialysis methods remove waste from the blood.

- Peritoneal dialysis occurs within the abdominal cavity and uses active transport as well as diffusion.
- Haemodialysis involves a dialysis machine and relies on simple diffusion.

Explain why peritoneal dialysis can use active transport and diffusion while haemodialysis relies on diffusion alone.

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[2]

- ii. Suggest **one** advantage and **one** disadvantage of a kidney transplant compared to dialysis.

advantage

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disadvantage

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[2]

(b). Cancer of the bladder or kidneys can now be detected using a simple procedure.

Suggest a non-invasive method that could be used to test for these cancers.

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[1]

14(a). Resistance training with weights can increase muscle mass in the body. It can also lead to vascularisation, where blood vessels become more visible through the skin. Fig. 19.1 shows vascularisation.



Fig. 19.1

Vascularisation occurs in bodybuilders because blood vessels are pushed to the surface by increased muscle mass. They can also become more visible due to reduced body fat and dehydration.

Explain why the visible blood vessels are likely to be veins.

[3]

(b). Some bodybuilders use anabolic steroids to increase their muscle mass.

Suggest why anabolic steroids are effective when applied to the surface of the skin.

[2]

(c). Illegal use of steroids is widespread in professional sport.

The International Olympic Committee (IOC) tests the urine of athletes to help prevent steroid abuse.

Fig. 19.2 is a graph showing tests carried out by the IOC between 1986 and 1994.

- The bars represent the number of urine samples tested.
- The line shows the percentage of samples testing positive for the steroid testosterone.

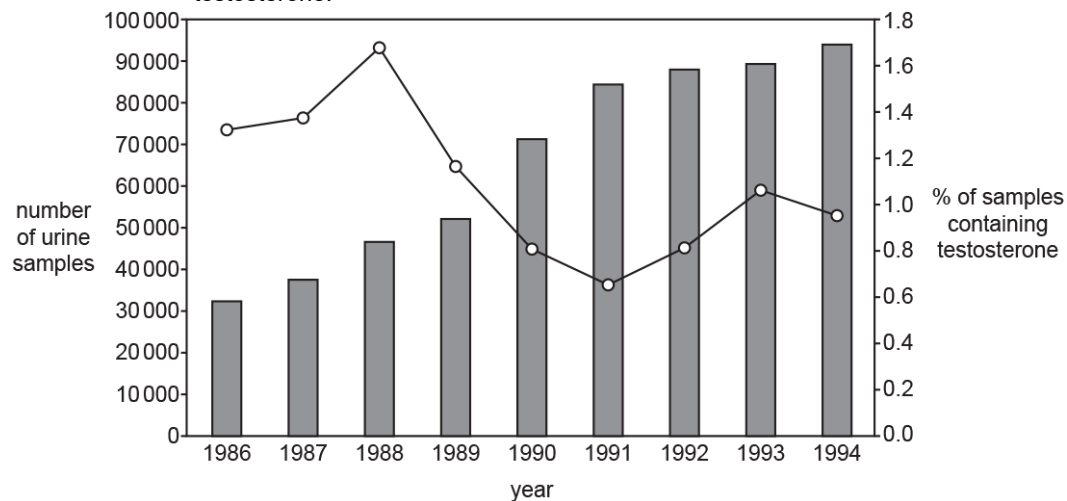


Fig. 19.2

- Calculate the change in the **number** of samples testing positive for testosterone between 1988 and 1991.

number of samples = [3]

