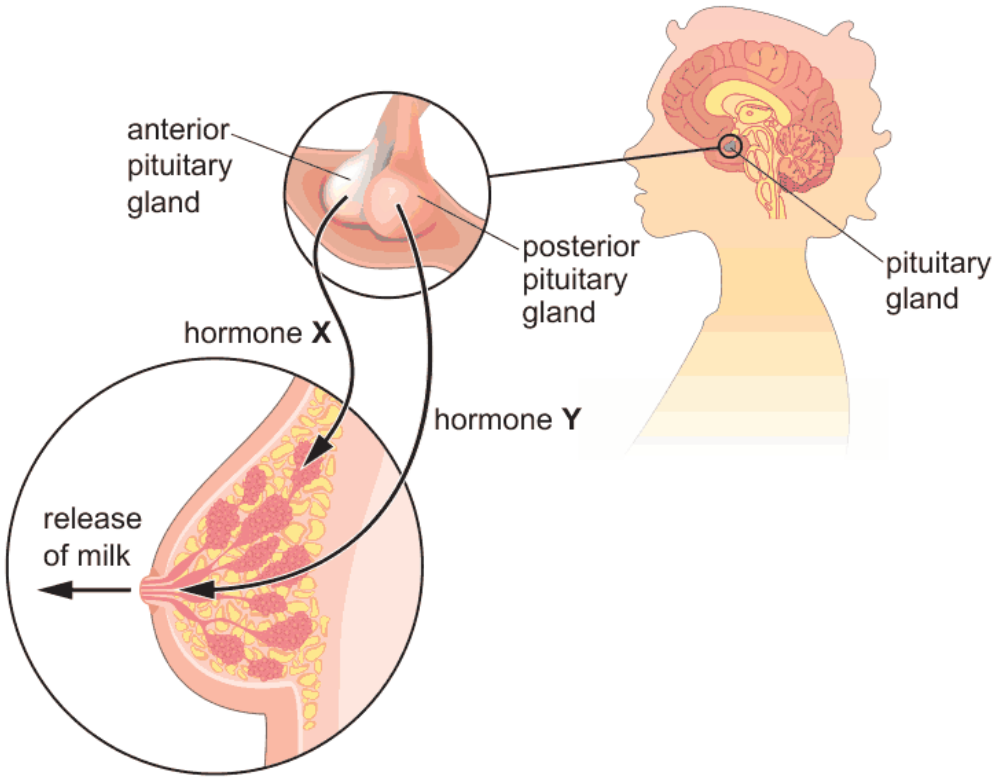
Homeostasis and the Kidney (3.4): Eduqas A Level Biology Exam Questions by Topic

23 questions · 46 marks · about 55 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · information from earlier in the question

(b) During breastfeeding, the baby feeds on milk from the mammary glands. **Image 1.3** shows the site of the action of two hormones involved in the control of lactation.

Image 1.3



Question 1 · A level Component 2 · June 2025 · Q1(b)(ii) · 1 mark

(ii) When the baby starts to feed from the mother there is increased secretion of these two hormones.
Suggest how this is an example of positive feedback. [1]

.....

.....

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Question 2 · information from earlier in the question

5. The kidneys play an important role in homeostasis through osmoregulation and the excretion of urine.

The volume of urine produced can be affected by both the glomerular filtration rate and the reabsorption of filtrate.

(a) To control the glomerular filtration rate, a protein is released by the body which causes vasoconstriction of the afferent arterioles. This protein functions as both an enzyme and a hormone.

Question 2 · A level Component 3 · June 2024 · Q5(a)(ii) · 2 marks

(ii) Describe what is meant by the term hormone and explain why the tertiary structure of this protein is important in its function as a hormone. [2]

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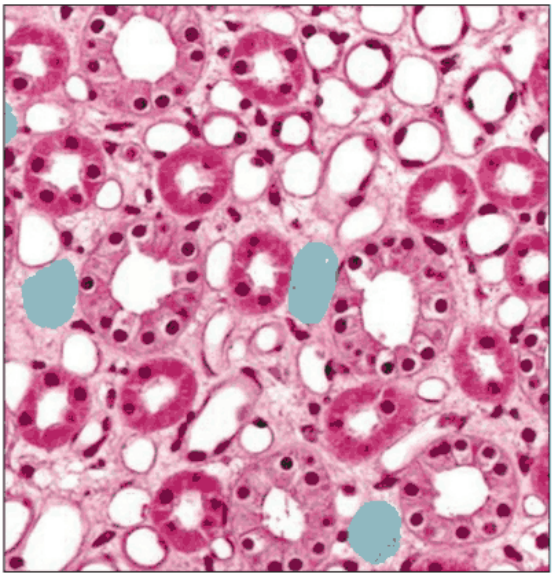
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4. **Image 4.1** shows a cross section through the medulla of the kidney.

Image 4.1



(a) (i) State the evidence shown in **image 4.1** that this is a section through the medulla and not through the cortex. [1]

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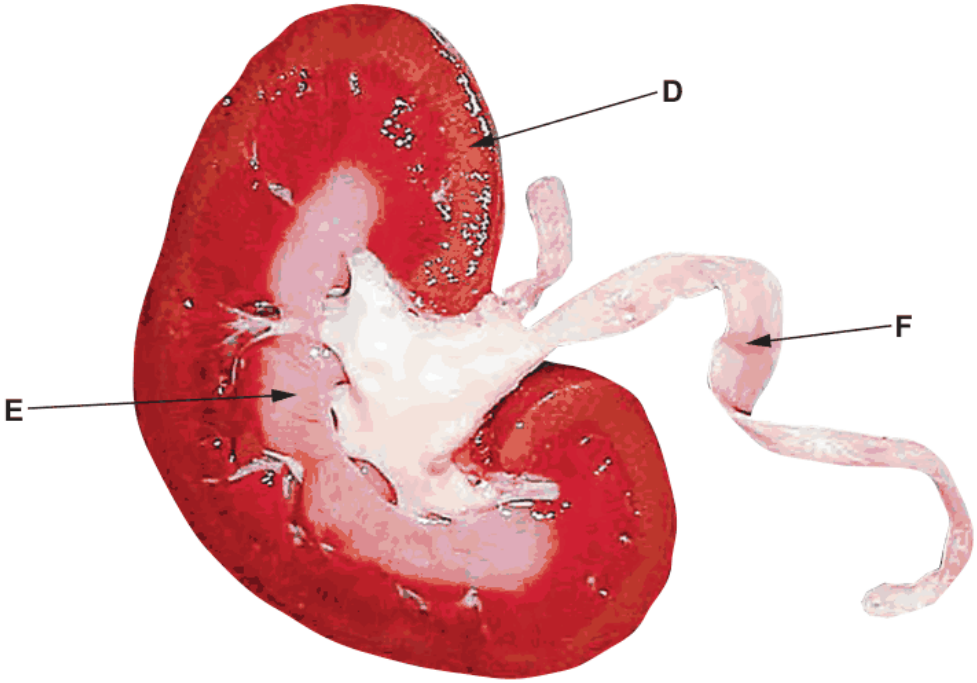
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Question 4 · A level Component 3 · June 2019 · Q2(a)(i) · 1 mark

2. Osmoregulation and urine formation in mammals is carried out by the nephrons. During this process, many small soluble molecules and ions are initially forced out of the blood by **ultrafiltration** in the glomerulus followed by **selective reabsorption** in the proximal convoluted tubule. The remaining filtrate is concentrated in the loop of Henle and collecting duct to produce urine.

Figure 2.1 shows a section through a mammalian kidney.

Figure 2.1



(a) (i) Name the parts of the kidney labelled **D**, **E** and **F** on figure 2.1. [1]

D .....

E .....

F .....

Question 5 · A level Component 3 · June 2019 · Q2(a)(ii) · 1 mark

(ii) Using letters **D**, **E** or **F** from figure 2.1, identify the part of the kidney in which each of the following processes takes place: [1]

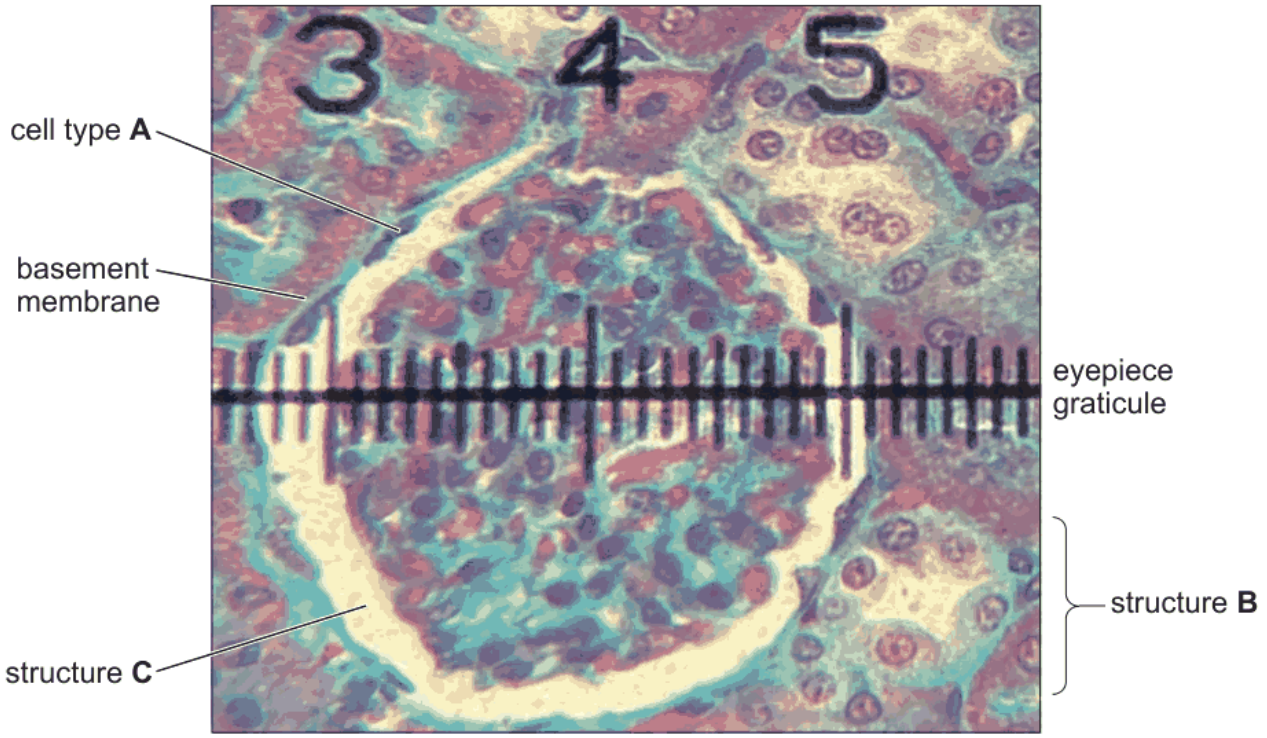
ultrafiltration .....

selective reabsorption .....

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(b) **Image 1.1** shows a section of kidney cortex that has been viewed using a ×40 objective lens. The microscope used was fitted with an eyepiece graticule.

Image 1.1



Identify cell type **A**, structure **B** and structure **C** on **Image 1.1**. [3]

cell type **A** .....

structure **B** .....

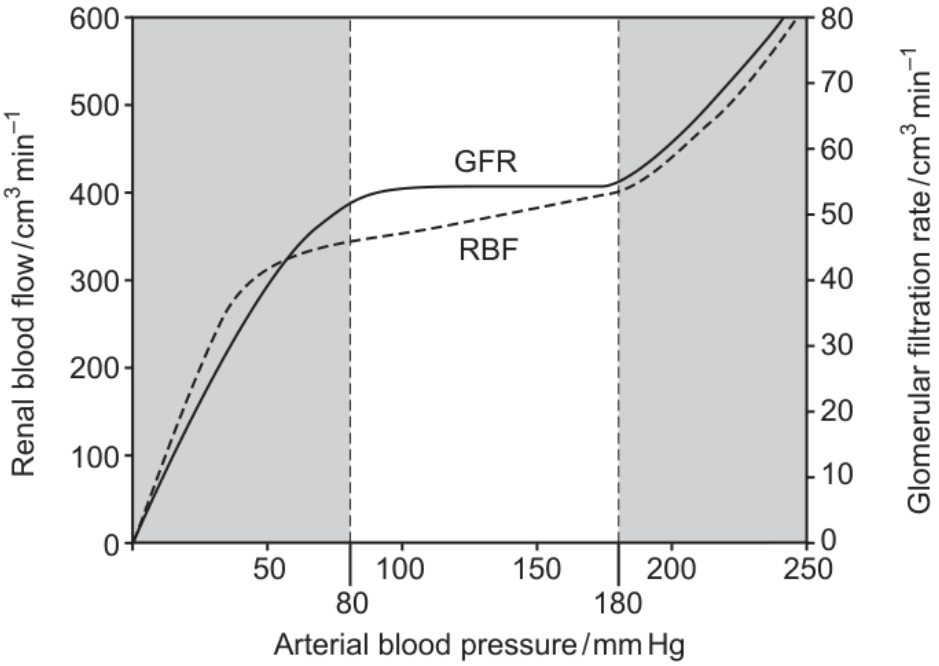
structure **C** .....

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Question 7 · A level Component 3 · June 2024 · Q5(b)(i) · 1 mark

(b) The relationship between arterial blood pressure, renal blood flow (RBF) (volume of blood entering kidney) and the glomerular filtration rate (GFR) is shown in **Graph 5**.

Graph 5



RBF = renal blood flow per minute in cm^3
GFR = Volume of glomerular filtrate produced per minute in cm^3

The normal range of arterial blood pressure in a healthy human adult is between 80 mm Hg at rest to 180 mm Hg during exercise.

Use **Graph 5** and the information given to answer the following questions:

(i) Explain how increasing RBF results in an increase in GFR as arterial blood pressure increases from 0 to 80 mm Hg. [1]

.....

.....

Question 8 · A level Component 3 · June 2024 · Q5(b)(ii) · 2 marks

(ii) Use your knowledge of vasoconstriction in the afferent arterioles to describe and explain the GFR between 80 and 180 mm Hg. [2]

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Question 9 · A level Component 3 · June 2024 · Q5(b)(iii) · 1 mark

(iii) Above 180 mm Hg GFR increases dramatically.
Suggest how the increase in GFR demonstrates that the kidneys are acting homeostatically to reduce blood pressure. [1]

.....

.....

Question 10 · A level Component 3 · June 2022 · Q4(b)(i) · 2 marks

(b) ADPKD is a condition that causes small fluid-filled sacs (cysts) to form in kidney tubules. This results in some kidney tubules becoming blocked. Other tubules in the kidney have a higher rate of filtration.

(i) Using your knowledge of ultrafiltration, explain why the body responds to ADPKD by increasing the blood pressure to above normal levels. [2]

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Question 11 · A level Component 3 · June 2019 · Q2(b)(i) · 2 marks

(b) Figure 2.2 shows a section through a proximal convoluted tubule of a mammal.

Figure 2.2



(i) Identify the structures labelled **X** on figure 2.2 and explain how they are involved in selective reabsorption by the proximal convoluted tubules. [2]

.....

.....

Question 12 · A level Component 3 · June 2019 · Q2(b)(ii) · 1 mark

(ii) Explain how the capillaries increase the rate of selective reabsorption. [1]

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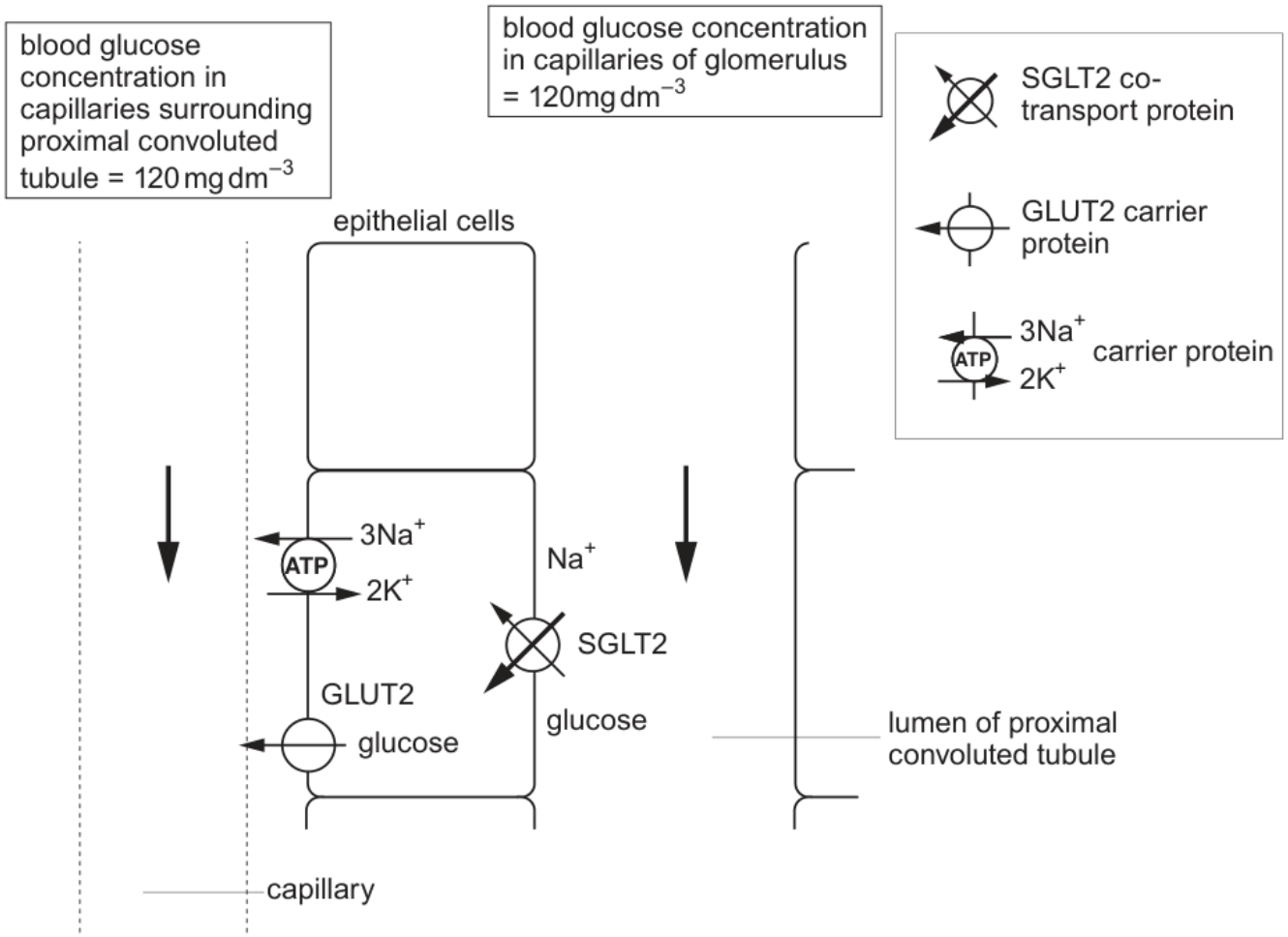
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Question 13 · information from earlier in the question

4. Type 2 diabetes affects nearly three million adults in the UK and is particularly prevalent in obese people. Under normal conditions, almost all of the filtered glucose is reabsorbed and returned to the circulation in the proximal convoluted tubule of the nephron but in people with type 2 diabetes, glucose starts to appear in the urine when blood glucose concentration exceeds 180 – 200 mg dm^{-3}.

The diagram below shows how glucose is reabsorbed in the first part of the proximal convoluted tubule.



Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 13 · A level Component 3 · June 2017 · Q4(a)(ii) · 4 marks

(ii) Explain how glucose is reabsorbed from the filtrate into the blood even at very high blood glucose levels. [4]

Question 14 · A level Component 3 · June 2017 · Q4(b)(i) · 2 marks

(b) Reabsorption of glucose into the blood of people with Type 2 diabetes can increase the risk of hyperglycaemia (dangerously high glucose levels). Under these conditions damage can be caused to the retina and other tissues. Scientists are trialling the use of an inhibitor of the SGLT2 co-transport protein as a possible method of controlling blood glucose levels.

(i) Using the information provided above and on page 12, explain how an SGLT2 inhibitor could be used to treat Type 2 Diabetes and control blood glucose levels. [2]

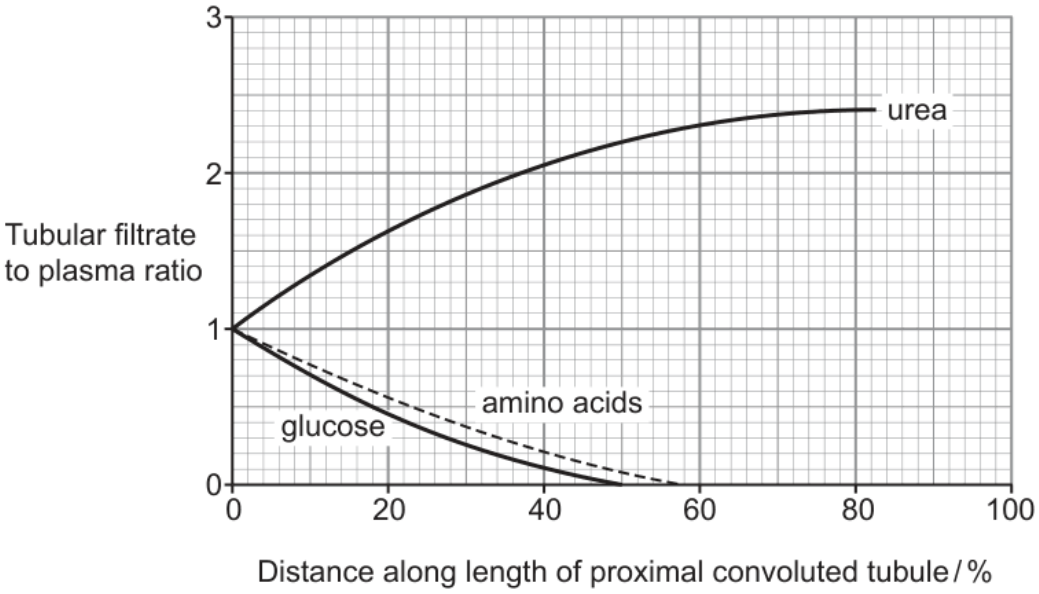
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Question 15 · A level Component 3 · June 2023 · Q4(a)(i) · 2 marks

4. In an adult human, approximately 180 dm^3 of fluid is filtered from the glomeruli into the Bowman's capsules per day. As the filtrate moves along the proximal convoluted tubules (PCT) some substances are selectively reabsorbed. By the time the filtrate has reached the end of the proximal convoluted tubules 70% of the water has been reabsorbed.

Graph 4.1 shows the change in the tubular filtrate to plasma ratio due to the reabsorption of water.

Graph 4.1



(a) Explain the change in tubular filtrate to plasma ratios for:

(i) glucose and amino acids; [2]

Question 16 · A level Component 3 · June 2023 · Q4(a)(ii) · 2 marks

(ii) urea. [2]

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Question 17 · A level Component 3 · June 2023 · Q4(c) · 2 marks

(c) People with uncontrolled Type 1 diabetes have high concentrations of blood glucose. This results in high concentrations of glucose in the glomerular filtrate. Not all of the glucose can be reabsorbed, resulting in the loss of glucose in the urine.
Use your knowledge of the transport of glucose to explain why not all the glucose can be reabsorbed. [2]

Question 18 · A level Component 2 · June 2022 · Q4(c) · 1 mark

(c) One symptom of cadmium poisoning in humans is the loss of high levels of glucose, phosphate ions and amino acids in the urine. Suggest which part of the nephron is affected by cadmium poisoning. [1]

Question 19 · A level Component 3 · June 2024 · Q5(c) · 4 marks

(c) Antidiuretic hormone (ADH) is a hormone that affects the volume of urine produced. Describe and explain the effect on the kidneys of a high concentration of antidiuretic hormone (ADH) in the blood. [4]

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Question 20 · A level Component 3 · Autumn 2020 · Q4(a)(ii) · 3 marks

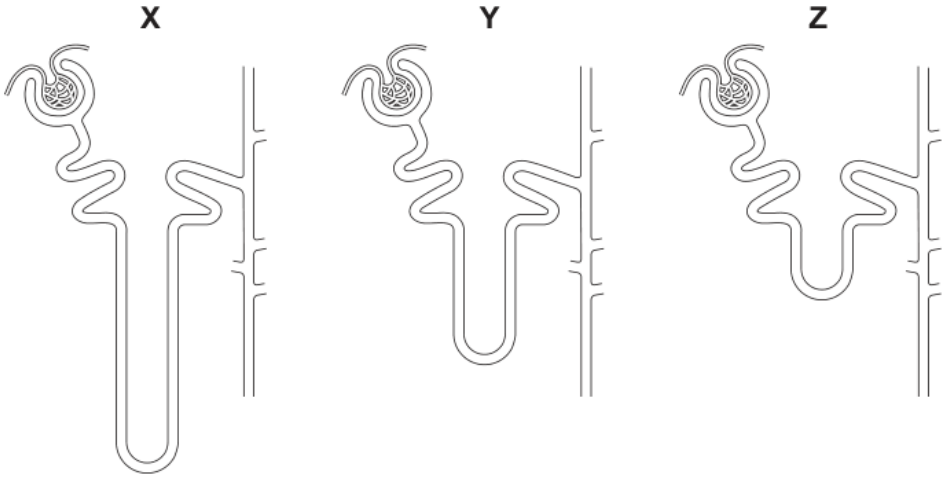
Patients with the condition Bartter syndrome have sodium ion and chloride ion channels in the ascending limb of the loop of Henle that are less effective than in people who do not have the condition.

(ii) Explain the effects of Bartter syndrome on the function of the nephron and suggest **one** symptom of this condition. [3]

Question 21 · A level Component 3 · Autumn 2020 · Q4(c) · 3 marks

(c) **Image 4.3** shows the nephrons of three different mammals **X**, **Y** and **Z**.

Image 4.3



Identify which nephron is most likely to belong to a mammal adapted to living in desert conditions. Explain your answer. [3]

Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 22 · A level Component 3 · June 2025 · Q5(b)(i) · 1 mark

(b) Nitrogenous waste, in the form of ammonia, is released by the gills of bony fish directly into the water. Other organisms release different forms of nitrogenous waste.

(i) State the main form of nitrogenous waste excreted by: [1]

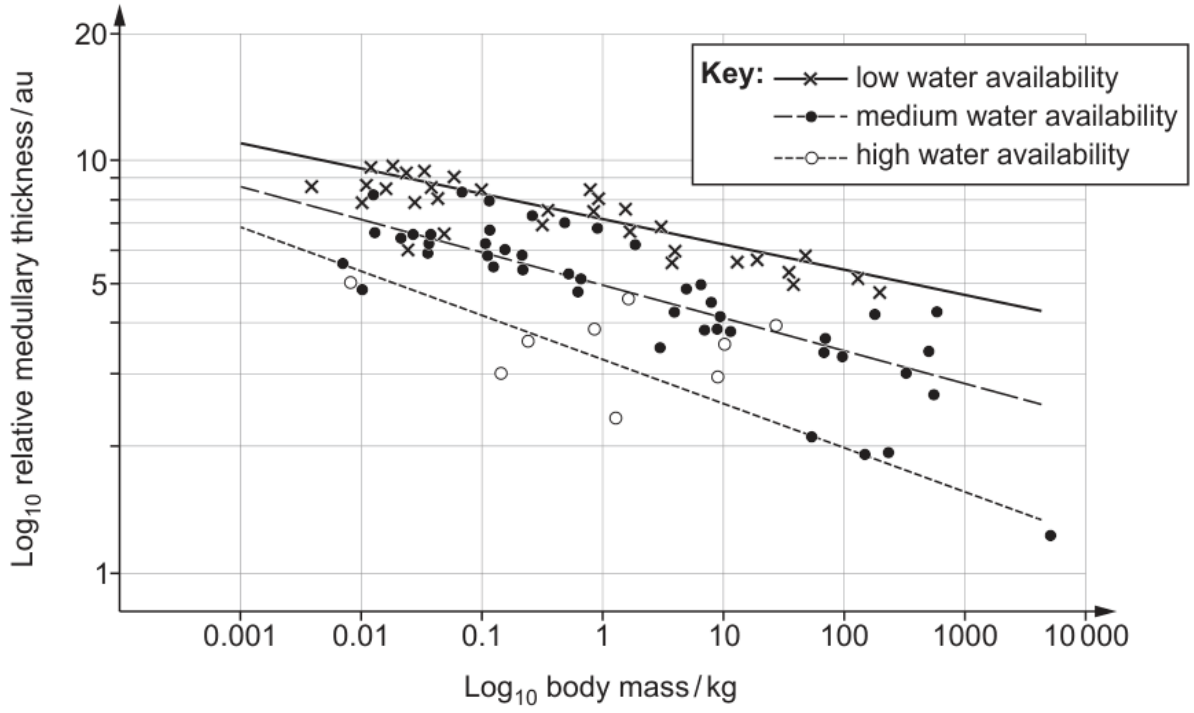
Mammals .....

Birds .....

Question 23 · information from earlier in the question

The medulla of the kidney contains the loop of Henle and the collecting ducts. **Graph 5.2** shows the relative medullary thickness in a range of organisms from habitat types with different levels of water availability.

Graph 5.2



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Question 23 · A level Component 3 · June 2025 · Q5(b)(iv) · 4 marks

(iv) Use **Graph 5.2** and your own knowledge to suggest how mammals living in habitats with a low water availability produce more concentrated urine.
No details of ADH are required. [4]

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Mark schemes

Question 1 · A level Component 2 · June 2025 · Q1(b)(ii) · 1 mark

		(ii)	{The more/ when} the baby feeds, the more hormone is {produced / released / owtte} and the more milk is {produced / released / owtte}	1 1

Question 2 · A level Component 3 · June 2024 · Q5(a)(ii) · 2 marks

(ii)	{Produced in / secreted from} {endocrine (system / glands) / ductless glands} (1) (3D shape to) bind with {specific / owtte} receptors (1)	1 1			2

Question 3 · A level Component 3 · Autumn 2020 · Q4(a)(i) · 1 mark

4	*(a)*	(i)	No glomeruli/ Bowman's capsules	1	1

Question 4 · A level Component 3 · June 2019 · Q2(a)(i) · 1 mark

2	*(a)*	(i)	**All three needed for 1 mark:** **D** cortex **E** medulla / renal pyramid **F** ureter	1 1	1

Question 5 · A level Component 3 · June 2019 · Q2(a)(ii) · 1 mark

(ii)	**Both needed for 1 mark:** 1 Ultrafiltration D Selective reabsorption D		1

Question 6 · A level Component 3 · June 2023 · Q1(b) · 3 marks

(b)		A = (Squamous) epithelial/ epithelium (1) B = Proximal convoluted tubule (1) Accept PCT/ DCT/ convoluted tubule 3 C = Bowman's capsule (1)	3			3

Question 7 · A level Component 3 · June 2024 · Q5(b)(i) · 1 mark

(b)	(i)	(results in a) higher (hydrostatic) <u>pressure</u> in the glomeruli	1	1

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Question 8 · A level Component 3 · June 2024 · Q5(b)(ii) · 2 marks

(ii)	GFR stays constant even though {RBF / arterial blood pressure} is increasing. (1) (Diameter of afferent arterioles decreases / afferent arterioles vasoconstrict) to reduce {blood flow / pressure} into the glomerulus. (1)	2	2

Question 9 · A level Component 3 · June 2024 · Q5(b)(iii) · 1 mark

	(iii)	(Above 180 higher GFR causes) (loss of) more {H_2O from the blood / urine / fluid from the body} (to reduce blood pressure)	1	1	

Question 10 · A level Component 3 · June 2022 · Q4(b)(i) · 2 marks

	(b)	(i)	(High blood pressure) increases (ultra)filtration rate/ more filtration/ or description of (1) {Higher rates/ more filtered} in {unaffected/ other} tubules {are needed to maintain normal rate/ to compensate/owtte}/ higher rates needed to compensate for blocked tubules (1)	2	2	

Question 11 · A level Component 3 · June 2019 · Q2(b)(i) · 2 marks

(b)	(i)	**X** = microvilli (1) Reject villi / cilia Increase surface area (1)		1 1	2

Question 12 · A level Component 3 · June 2019 · Q2(b)(ii) · 1 mark

	(ii)	Maintain concentration gradient/ Thin walls to reduce diffusion distance (1)		1	1	

Question 13 · A level Component 3 · June 2017 · Q4(a)(ii) · 4 marks

(ii)		**Any 4 (x1) from:** A. Na^+ ions actively {transported/ pumped} out of (epithelial) cell (1) B. lowers concentration of Na^+ inside cell (1) C. Na^+ in filtrate at a higher concentration than inside (epithelial) cell (1) D. Na^+ co-transported with glucose into epithelial cell (1) E. Glucose concentration in epithelial cell higher than blood plasma F. Glucose moves out of epithelial cell into blood by facilitated diffusion (1) G. circulation maintains plasma concentration below that in epithelial cells/ maintains concentration gradient (1)	1 1	 1 1	4	

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Question 14 · A level Component 3 · June 2017 · Q4(b)(i) · 2 marks

(b)	(i)	use of inhibitor would {reduce level of glucose reabsorbed / reducing cotransport}/ owtte(1) so more glucose would be lost in urine (1)	2		2

Question 15 · A level Component 3 · June 2023 · Q4(a)(i) · 2 marks

4	(a)	(i)	**Any two (x1) from** (Ratio) goes {down/ to zero} (1) (they are) (re)absorbed / move back (from filtrate into blood) (1) By cotransport/ facilitated diffusion/ secondary active transport (1)	1	1	2

Question 16 · A level Component 3 · June 2023 · Q4(a)(ii) · 2 marks

(ii)	**Any two (x1) from** Urea ratio (in the filtrate) increases (1) (because) water reabsorbed/ volume decreases (1) but urea {not (all) reabsorbed/ stays in the filtrate} (1)	1	1	2	

Question 17 · A level Component 3 · June 2023 · Q4(c) · 2 marks

(c)	(Glucose reabsorbed using) co-transport/ facilitated diffusion/ secondary active transport (1) **Any one (x1) of** {Proteins/ protein carriers} are saturated (at high glucose concentrations)/ limited number of carrier proteins/ owtte (1) OR Low sodium ion concentration limits (cotransport) (1)	2		2

Question 18 · A level Component 2 · June 2022 · Q4(c) · 1 mark

(c)	Proximal convoluted tubule / PCT	1	1		

Question 19 · A level Component 3 · June 2024 · Q5(c) · 4 marks

(c)		A. ADH increases permeability (to water) {DCT/ collecting duct walls} (1) B. aquaporins inserted into membranes/ owtte(1) C. Water reabsorbed into {tissue fluid / blood/ vasa recta/ capillaries/ medulla}(1) D. Low volumes of concentrated urine produced (1)	4		4

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Question 20 · A level Component 3 · Autumn 2020 · Q4(a)(ii) · 3 marks

(ii)	Any **two** (x1) from: Sodium ions/ chloride ions lost in urine/ not absorbed into tissue fluid (1) Less water reabsorbed from collecting duct/ descending limb into the blood (1) Lower water potential gradient (1) Any **one** (x1) from: Increased urination (1) Dehydration (1)	3		3

Question 21 · A level Component 3 · Autumn 2020 · Q4(c) · 3 marks

(c)	X (no mark) has longest loop of Henle (1) Longer loop increases concentration difference between filtrate and tissue fluid (1) More water reabsorbed (1)	1	2	3

Question 22 · A level Component 3 · June 2025 · Q5(b)(i) · 1 mark

(b)	(i)	Mammals – urea Birds – Uric acid **both needed for 1 mark**	1			1

Question 23 · A level Component 3 · June 2025 · Q5(b)(iv) · 4 marks

(iv)	**Any four (x1) from** Mammals living in areas with low water availability A. have a thicker medulla (1) B. which contains longer {loops of Henle /collecting duct} (1) C. More {ions/ correct named ions} pumped into {medulla/ tissue fluid} (from ascending limb of loop of Henle) (1) D. (Therefore,) more negative <u>water potential</u> in medulla/ owtte (1) E. More water {reabsorbed from/ moves out of} {(descending limb) loop of Henle/collecting duct} (1)	4	4	

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