Homeostasis and Excretion (5.1.1–5.1.2): OCR A Level Biology Exam Que

20 questions · 49 marks · about 59 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 1 · June 2023 · Q20(a)(i) · 1 mark

20 (a) Organisms can be ectotherms or endotherms.

(i) Define the term **endotherm**.

.....

..... **[1]**

Question 2 · A level Paper 1 · June 2023 · Q20(a)(ii) · 2 marks

(ii) Suggest **one** advantage and **one** disadvantage that ectotherms have compared to endotherms.

Advantage .....

.....

Disadvantage .....

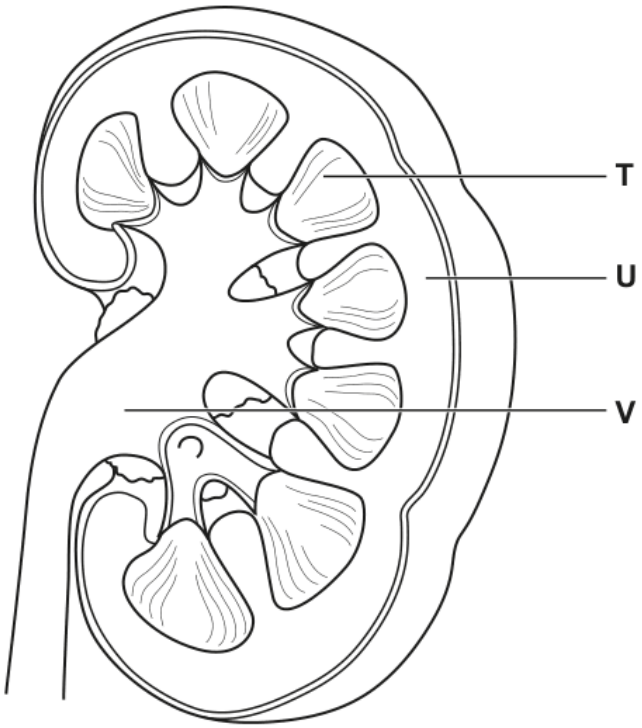
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[2]

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(b) (i) **Fig. 19.1** is a drawing of a longitudinal section of a kidney.

Fig. 19.1



Identify the parts of the kidney labelled **T**, **U** and **V**.

T .....

U .....

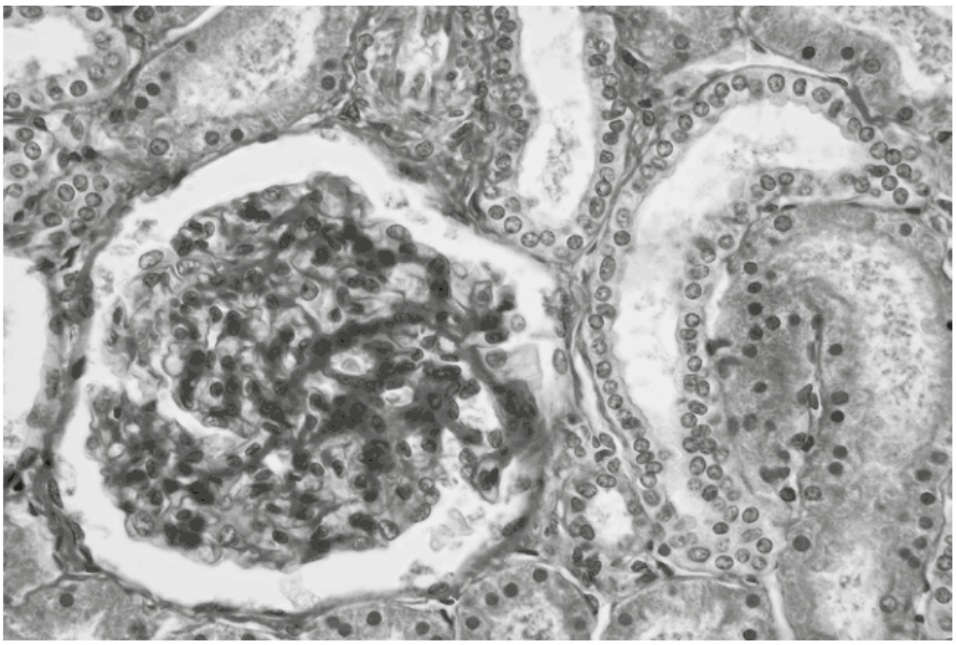
V .....

[3]

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(ii) **Fig. 19.2** is a photomicrograph of a cross-section of part of the kidney.

Fig. 19.2



× 360

Using the letter **T**, **U** or **V** from **Fig. 19.1**, identify the part of the kidney that was used to make the cross-section in **Fig. 19.2**.

Give a reason for your identification.

Letter representing part of the kidney .....

Reason .....

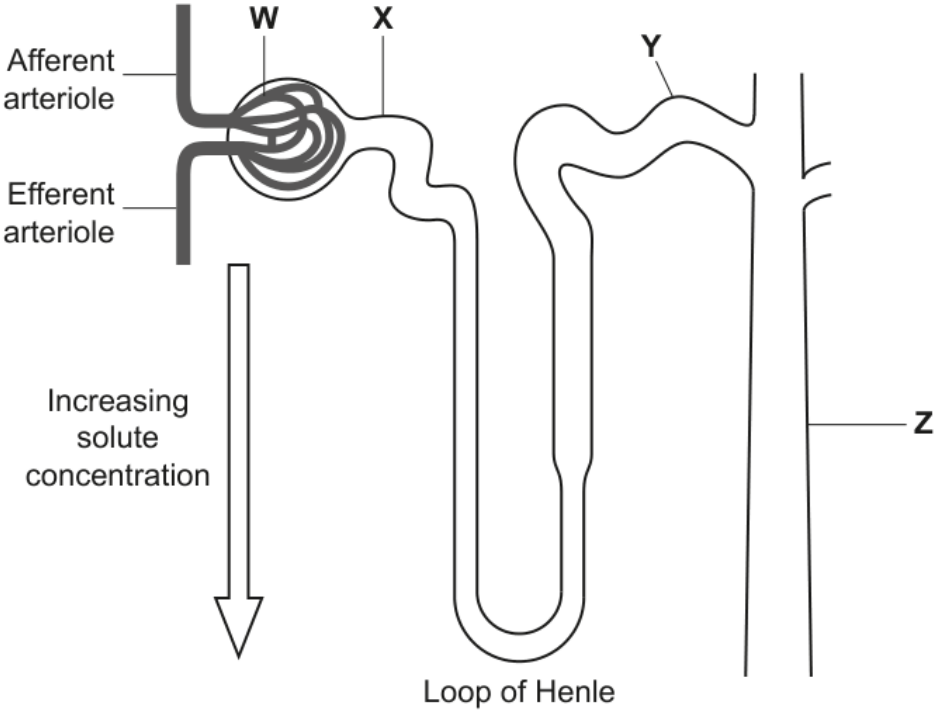
.....

[2]

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(c) **Fig. 19.3** is a diagram of a single nephron.

Fig. 19.3



(i) Complete the table using the most appropriate letter or letters, **W** to **Z**, to show which part(s) of the nephron correspond to each of the statements.

Each letter may be used once, more than once or not at all.

Statement	Letter or letters
ADH increases the permeability of the walls	
This region has the highest hydrostatic pressure	
Movement of mineral ions occurs to maintain the balance of mineral ions in the blood	

[3]

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Question 6 · A level Paper 1 · June 2023 · Q19(c)(ii) · 3 marks

(ii) **Fig. 19.3** shows an increasing solute concentration.

Outline the processes in the loop of Henle that cause the solute concentration to increase.

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..... **[3]**

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1 (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]

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Question 8 · information from earlier in the question

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

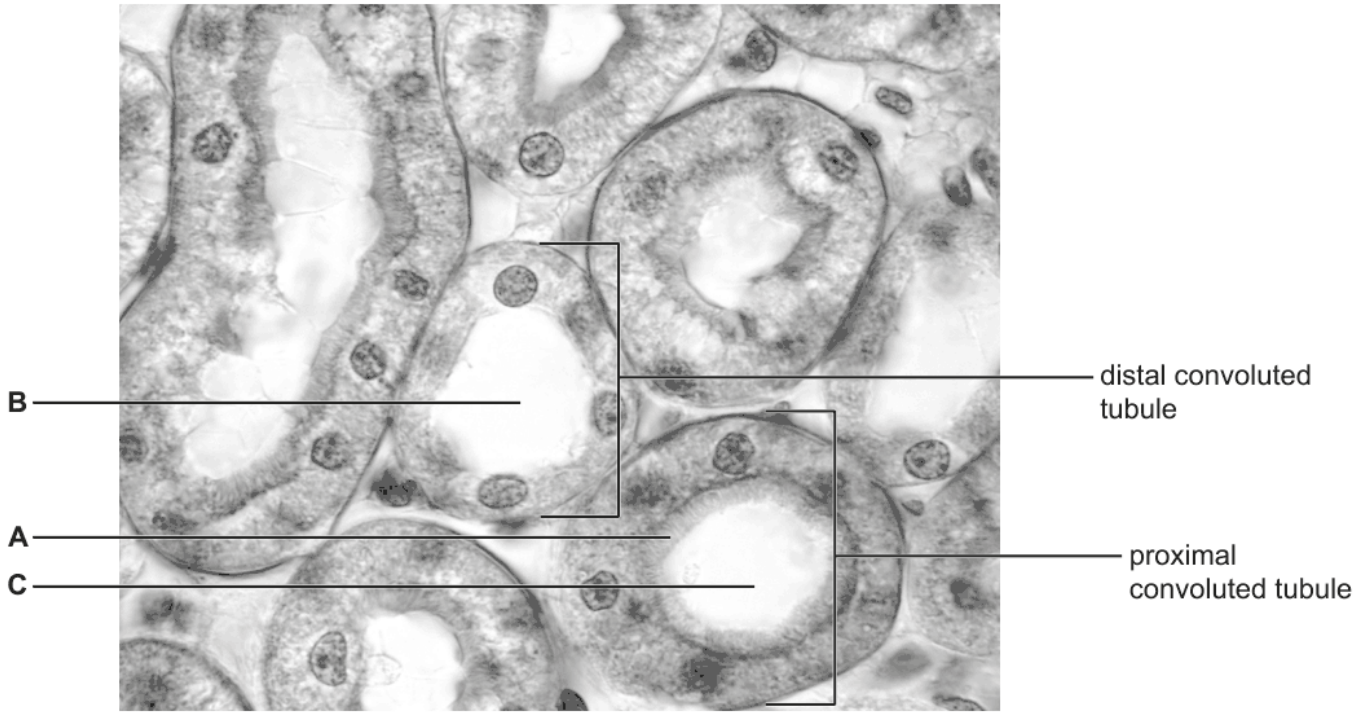


Fig. 1.2

(i) State one function of the distal convoluted tubule.

.....

..... **[1]**

Question 8 · A level Paper 3 · November 2020 · Q1(b)(ii) · 1 mark

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

.....

..... **[1]**

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2 Fig. 2.1 shows a naked mole rat, *Heterocephalus glaber*.



Fig. 2.1

The naked mole rat is a mammal. However, it has several features that are unusual for mammals.

(a) Naked mole rats regulate their temperature in a way that is different from most mammals.

(i) Some features of thermoregulation in naked mole rats are listed below:

- They live in complex underground tunnel systems, which tend to have a stable temperature of 30–32 °C. However, sometimes the environmental temperature can increase or decrease outside this range.
- In experiments that examine environmental temperature changes, the core body temperature of naked mole rats remains close to that of the environmental temperature.
- When tunnel temperature increases they often move to cooler parts of the tunnel system.
- When tunnel temperature decreases they often lie together in large groups.

Outline **two** ways in which thermoregulation in naked mole rats is different from thermoregulation in most mammals.

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..... **[2]**

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Question 10 · A level Paper 3 · June 2019 · Q2(a)(ii) · 4 marks

(ii) In humans, when core body temperature falls below 35 °C, positive feedback causes this decrease in core body temperature to continue. This process is known as hypothermia.

Explain how positive feedback could accelerate the process of hypothermia.

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..... **[4]**

Question 11 · A level Paper 3 · June 2019 · Q2(a)(iii) · 2 marks

(iii) Mammals, including naked mole rats, have temperature receptors that play a role in thermoregulation.

The table below lists four statements about mammalian temperature receptors.

Write either 'true' or 'false' in the empty boxes to indicate whether each statement is true or false.

Statement	True or False?
Peripheral temperature receptors detect the temperature of internal organs	
Receptors in the hypothalamus detect core body temperature	
Blood temperature is detected by the receptors in the hypothalamus	
Temperature receptors send impulses to the medulla oblongata, which regulates body temperature	

[2]

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Question 12 · A level Paper 1 · June 2023 · Q20(c)(i) · 2 marks

(c) Infection by pathogens such as bacteria and viruses often causes release of pyrogens into the blood.

Pyrogens stimulate the enzyme COX-2 to produce the compound PGE_2.

PGE_2 binds to receptors in the hypothalamus and this results in an increase in the thermogenic set point.

(i) Suggest the consequences of an increase in the thermogenic set point.

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..... **[2]**

Question 13 · A level Paper 3 · November 2020 · Q6(c) · 2 marks

(c) When old red blood cells are broken down, each haem group is converted to a molecule called bilirubin. Bilirubin passes through the digestive system. Bilirubin gives faeces their characteristic colour.

Explain why bilirubin production and processing is an example of excretion.

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..... **[2]**

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17 Cirrhosis of the liver can result from long-term liver damage. Alcohol or other toxins can cause this damage.

Scientists have suggested that cirrhosis can be detected by taking samples of body fluids and testing them for two different molecules: C-reactive protein and copeptin.

The liver produces these two molecules, and increased levels can indicate liver damage due to cirrhosis.

Different bodily fluids from a patient suspected of having cirrhosis were tested for C-reactive protein and copeptin.

Fig. 17.1 is a graph of the results.

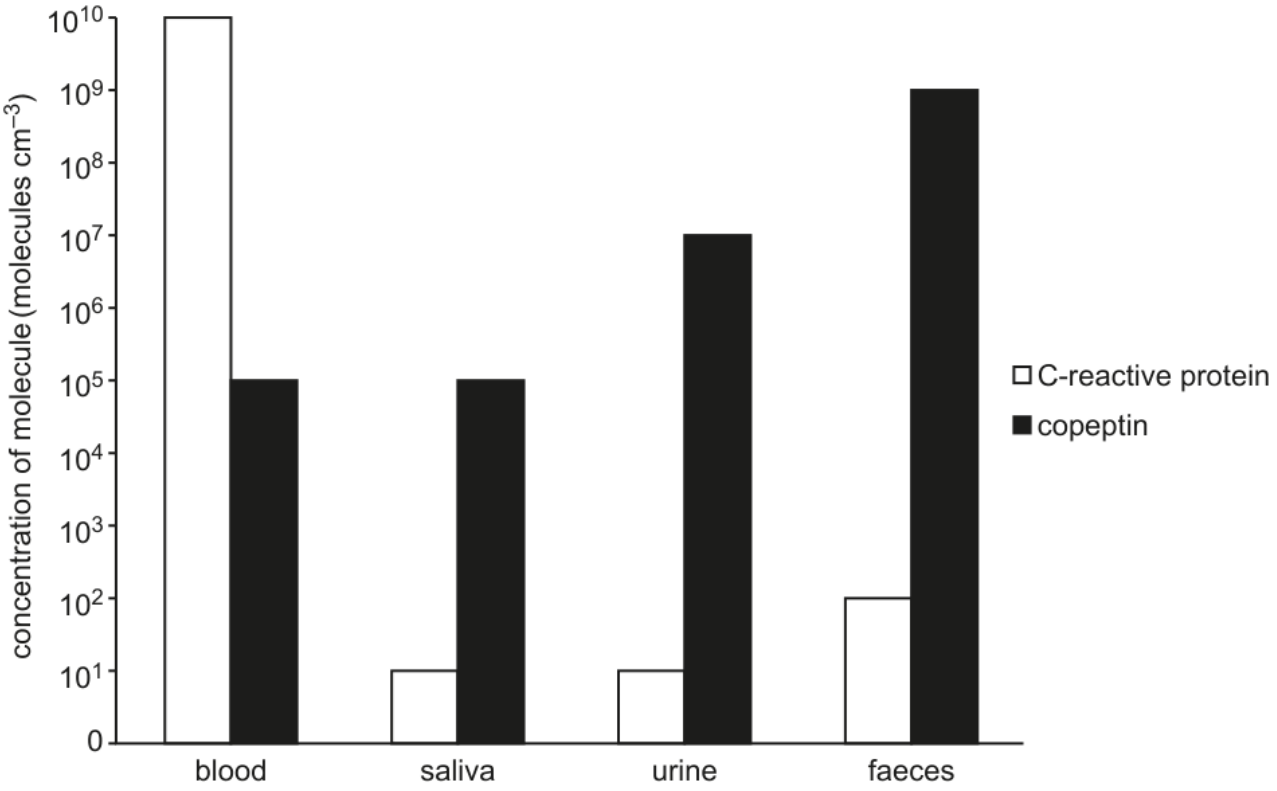


Fig. 17.1

(a) Different bodily fluids have different concentrations of the different molecules.

(i) Calculate the order of magnitude by which concentration of copeptin in the **faeces** is higher than the concentration of C-reactive protein in the **saliva**.

Show your working.

Answer = ... molecules cm^{-3} **[2]**

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Question 14 · A level Paper 1 · June 2017 · Q17(a)(ii) · 2 marks

(ii) Suggest why blood and faeces have the highest concentrations of C-reactive protein and copeptin.

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..... **[2]**

Question 15 · information from earlier in the question

18

(a) Furosemide is a type of drug known as a diuretic that acts on the nephron to decrease reabsorption of water in the collecting ducts. Diuretics are often prescribed to treat high blood pressure.

Furosemide is on the list of banned substances published by the International Olympic Committee.

(i) State **one** other type of drug on the list of banned substances that can be detected in urine samples.

..... **[1]**

Question 15 · A level Paper 1 · June 2024 · Q18(a)(ii) · 2 marks

(ii) Furosemide can also be misused by jockeys or boxers who need to be below a certain weight.

Explain how a diuretic could help to reduce weight.

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..... **[2]**

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Question 16 · A level Paper 1 · June 2024 · Q18(b)(ii) · 1 mark

(ii) Give **one** other application of urine analysis in diagnosis.

State the substance measured and the corresponding medical condition.

Substance .....

Medical condition .....

[1]

Question 17 · A level Paper 3 · June 2018 · Q6(b)(i) · 4 marks

(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]

Question 18 · A level Paper 3 · June 2018 · Q6(b)(ii) · 1 mark

(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]**

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Question 19 · A level Paper 1 · June 2023 · Q16(d) · 4 marks

(d) Changes to kidney function during pregnancy can be confused with some diseases, such as chronic kidney disease or kidney failure.

The estimated glomerular filtration rate (eGFR) in a healthy 30–39-year-old is 107 $cm^3 min^{-1}$. The eGFR usually decreases with age but in pregnancy, can increase by between 50 and 85%.

The table shows the results of some of the physiological measurements that a clinic carried out on two 35-year-old women. One of the patients was pregnant.

Measurement	Patient A	Patient B
eGFR ($cm^3 min^{-1}$)	162	35
Blood glucose concentration	Normal	Slightly high
Urine glucose concentration	Moderately high	Slightly high
Urine protein concentration	Slightly high	Very high
Blood electrolytes Na^+, K^+, Cl^-	Normal	High

A doctor concluded that patient A was undergoing a normal pregnancy whereas patient B was suffering from kidney failure.

Explain the doctor's conclusion.

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..... **[4]**

Turn over

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Question 20 · A level Paper 1 · June 2024 · Q18(d) · 6 marks

(d)* Describe the homeostatic mechanisms that regulate the water content of the blood by changing how much water is reabsorbed from the collecting duct.

You do **not** need to describe how the loop of Henle sets up a water potential gradient in your answer.

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..... **[6]**

Extra answer space if required.

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Mark schemes

Question 1 · A level Paper 1 · June 2023 · Q20(a)(i) · 1 mark

20	**(a)**	**(i)**	(endotherm) uses heat produced , within / internally , to maintain body temperature ✓	

1	1.1	**ALLOW** uses heat from metabolic processes to maintain body temperature **IGNORE** control

Question 2 · A level Paper 1 · June 2023 · Q20(a)(ii) · 2 marks

20	**(a)**	**(ii)**		*advantage **one** from:*	**max 2** 1.1
			1	less , food / energy , used / needed ✓	
			2	more , energy / nutrients , can be used for , growth / reproduction ✓	
			3	less time spent , feeding / finding food ✓	
				*disadvantage **one** from:*	
			4	metabolism slows / less active , at low(er) (environmental) temperatures ✓	
			5	can be at risk from predators when body temperature is low ✓	
			6	less able / unable to , hunt for / find , food when body temperature is low ✓	

MP2 IGNORE food
MP2 ALLOW named nutrients e.g. glucose

MP3 ALLOW able to survive in habitats with low availability of food

MP4 ALLOW less able / unable , to live in cold climates
MP4 ALLOW susceptible to freezing

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Question 3 · A level Paper 1 · June 2023 · Q19(b)(i) · 3 marks

19	**(b)**	**(i)**	T = (renal) medulla ✓ U = (renal) cortex ✓ V = pelvis ✓	
			3 2.3	**ALLOW** (renal) pyramid

Question 4 · A level Paper 1 · June 2023 · Q19(b)(ii) · 2 marks

19	**(b)**	**(ii)**	U ✓ (shows) glomerulus / Bowman's capsule ✓	
			2 2.3	**ALLOW** cortex

Question 5 · A level Paper 1 · June 2023 · Q19(c)(i) · 3 marks

19	**(c)**	**(i)**	Z ✓ W ✓ Y ✓	**3** 2.1	**IGNORE** Y

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Question 6 · A level Paper 1 · June 2023 · Q19(c)(ii) · 3 marks

19 (c) (ii)			**max 3**	1.2
	1	ascending limb is impermeable to water / water cannot leave the ascending limb ✓		
	2	Na^+ / Cl^- , diffuse , out of lower part of ascending limb ✓		
	3	active transport of , Na^+ / Cl^- , out of (upper part of) ascending limb ✓		
	4	diffusion of , Na^+ / Cl^- , into descending limb ✓		
	5	water leaves the descending limb by osmosis ✓		
	6	ref to countercurrent multiplier ✓		

MP2 to **MP4 ALLOW** sodium / Na / chloride / Cl , ions
MPs 2 to **4** if only 'ions' used or incorrect ions e.g. K^+ apply ECF once only
MP2 and **MP4 ALLOW** down concentration gradient for diffusion
MP3 ALLOW pumped for active transport

MP5 ALLOW down water potential gradient for osmosis

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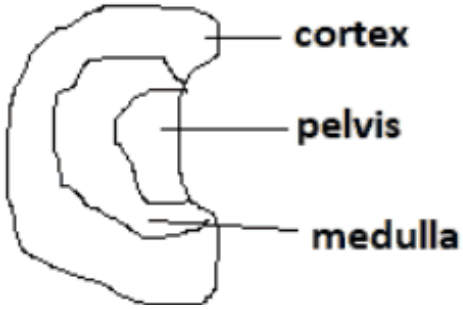
Question 7 · A level Paper 3 · November 2020 · Q1(a) · 2 marks

1	a	line drawing with clear continuous lines ✓ pelvis, medulla and cortex correctly labelled ✓	2	1.1 2.3

ALLOW a variety of shapes and sizes for the cortex medulla and pelvis (but they must be in the correct positions and clear)
ALLOW any orientation of drawing e.g. pelvis on the left
DO NOT ALLOW incomplete, overlapping or sketched lines
DO NOT ALLOW shading or cross-hatching
DO NOT ALLOW ureter or blood vessels shown

DO NOT ALLOW if label lines incorrectly drawn (e.g. not straight or have arrowheads) or do not start exactly at the structure being labelled

e.g. 2 marks for the answer below:



Question 8 · A level Paper 3 · November 2020 · Q1(b)(ii) · 1 mark

ii	increase(s) surface area for, (re)absorption/active transport ✓ has, cotransporters / membrane proteins, for, (re)absorption / active transport, of Na^+ / amino acid /glucose ✓	1 max	2.1

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Question 9 · A level Paper 3 · June 2019 · Q2(a)(i) · 2 marks

2	**a**	**i**	naked mole rats, have a lower body temperature / AW ✓ naked mole rats use, **more** behavioural responses / use **fewer** physiological responses (to thermoregulate) / described ✓ (core) body temperature of naked mole rats, is not maintained within a narrow(er) range / changes (with environmental temperature) ✓ no fur / hair , to trap layer of (insulating) air / for insulation ✓

2 max	*Assume 'they' or 'it' refers to naked mole rats* **ORA** for other mammals **IGNORE** 'mammals are endotherms and mole rats are ectotherms' **ALLOW** 'most mammals are 37°C and naked mole rats are 30-32°C' e.g. 'they huddle together when temperature falls whilst mammals shiver' or ' they move to cooler parts when temperature rises whilst mammals sweat' **IGNORE** 'naked mole rats body temperature matches environmental temperature' **IGNORE** ref to no subcutaneous fat layer / no sweat glands **ALLOW** 'no hair so cannot trap heat'

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Question 10 · A level Paper 3 · June 2019 · Q2(a)(ii) · 4 marks

a	**ii**	positive feedback, is when an initial (biological) change is, increased further / exaggerated / AW ✓ lower temperature reduces kinetic energy (of molecules) ✓ enzyme activity, slowed / reduced ✓ respiration rate / metabolism, slowed / reduced ✓ less (metabolic / internal) heat generated ✓ (so that body) temperature drops further ✓

4 max	e.g. 'it is when a change causes system to go further from, norm / optimum' 'it is when a decrease leads to a further decrease' **ALLOW** fewer successful collisions / fewer ESCs formed **IGNORE** enzymes stop working / no enzyme activity **ALLOW** the rate of reactions (in the body) is, reduced / slowed down **IGNORE** respiration stops **ALLOW** less heat, produced / created *'change causes system to go further from, norm / optimum and so a decrease in temperature leads to further decrease' = mp1 and 6*

Question 11 · A level Paper 3 · June 2019 · Q2(a)(iii) · 2 marks

a	**iii**	False True True False ✓✓	**2**	**ALLOW** T and F for True and False **ALLOW** ticks and crosses for True and False (when unambiguous) All correct ✓✓ 2 or 3 correct ✓

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Question 12 · A level Paper 1 · June 2023 · Q20(c)(i) · 2 marks

20	**(c)**	**(i)**	(increase in set point) will result in fever ✓ raised body temperatures help to , kill / prevent increase in number of , pathogens ✓ causes an increase in antibody production / faster immune response ✓ high body temperature can result in organ , damage / failure ✓

max 2	2.1	**ALLOW** viruses / bacteria for pathogens **IGNORE** affects enzyme activity

Question 13 · A level Paper 3 · November 2020 · Q6(c) · 2 marks

c	(bilirubin is a) metabolic waste product / described ✓ as produced, from haem / during (red blood cell) breakdown ✓ (bilirubin) removed / AW, from the body ✓
	Total

2	1.2 2.5	**ALLOW** (bilirubin) removed into the digestive system
70		

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Question 14 · A level Paper 1 · June 2017 · Q17(a)(ii) · 2 marks

(a)	(ii)	liver has , large / good / AW , blood supply ✓ released / secreted / AW , into bile ✓	2

IGNORE reference to C-reactive protein and copeptin throughout

ALLOW liver has sinusoids

Question 15 · A level Paper 1 · June 2024 · Q18(a)(ii) · 2 marks

18	(a)	(ii)	*idea that* collecting duct becomes less permeable to water ✓ (rapid) water loss ✓ larger volume of urine produced ✓	**max 2**

ALLOW e.g. fewer aquaporins inserted into collecting duct wall

ALLOW reduction in 'water weight'
ALLOW more water lost in urine

ALLOW more / greater amount of urine produced

Question 16 · A level Paper 1 · June 2024 · Q18(b)(ii) · 1 mark

18	(b)	(ii)	any **one** from (needs substance and application): glucose **AND** diabetes **OR** protein **AND** kidney disease / albuminuria **OR** creatinine **AND** kidney disease / muscle damage ✓	**max 1**

ALLOW other correct substance and condition e.g. hCG **AND** pregnancy

ALLOW kidney failure / kidney damage for kidney disease

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Question 17 · A level Paper 3 · June 2018 · Q6(b)(i) · 4 marks

6	b	i		4 max

age ✓
(because) GFR / kidney function , declines with age ✓

gender ✓
(because) men and women have different muscle mass ✓

exercise / muscle activity / muscle mass / fitness / pregnancy / body mass ✓
(because this will) alter, metabolism of creatine (phosphate) / production of creatinine ✓

diet ✓
(because this will) affect levels of, creatine (phosphate) / creatinine (in the blood) ✓

ethnicity / genetic make up ✓
different alleles, affect metabolism of creatine (phosphate) / production of creatinine ✓

Mark first two characteristics given

Only award mark for explanation if correctly linked to characteristic

IGNORE chances of kidney failure increase with age

ALLOW 'more / less, creatinine / product (in blood)'
ALLOW 'more / less, creatine (in muscle)

ALLOW use of creatine supplements

Question 18 · A level Paper 3 · June 2018 · Q6(b)(ii) · 1 mark

ii	*idea that* large proteins, should remain in the blood / not enter, Bowman's capsule / nephron ✓	
		Total

1	e.g. 'proteins / albumin, too large to cross the basement membrane' ' proteins are too large to be filtered and be present in the urine'
70	

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16 (d)		*Patient **A***	**max 4**	3.2, 2.2
	1	increase in eGFR which is in line with that expected during pregnancy / AW ✓		
	2	(high eGFR) explains increase in (urine concentration of) , glucose / protein ✓		
		*Patient **B***		
	3	has much lower eGFR than a healthy person ✓		
	4	less / no , ultrafiltration so level of (named) electrolytes is high(er) than healthy person ✓		
	5	very high protein (concentration) in urine indicates damage to , nephron / glomerulus / Bowman's capsule ✓		
	6	correct calculation to support statement for **either** patient **A** or patient **B** ✓		

MP1 ALLOW patient **A** has eGFR about 50% higher than normal which is consistent with pregnancy

MP3 ALLOW patient B has very low eGFR compared to normal / 107cm^3 min^{-1}
MP4 IGNORE ref. to reabsorption

MP5 ALLOW ...in basement membrane / renal corpuscle

MP6 is awarded **once** only for patient **A** or **B**
e.g. Patient **A** has 51.4% / 51% increase in eGFR
e.g. Patient **A** 50% is 161 and 85% is 198 so eGFR within range
e.g. Patient **B** eGFR has decreased by 67.3% / 67%

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Question 20 · A level Paper 1 · June 2024 · Q18(d) · 6 marks

18	**(d)***		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Describes in detail the regulation of the water content of blood with reference to action of ADH **AND** role of receptors **AND** (posterior) pituitary *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Describes the regulation of the water content of blood with reference to action of ADH **AND** receptors **OR** Describes the regulation of the water content of blood with reference to receptors **AND** (posterior) pituitary **OR** Describes the regulation of the water content of blood with reference to action of ADH **AND** (posterior) pituitary *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Describes the regulation of water content of blood with reference to the action of ADH **OR** receptors **OR** (posterior) pituitary *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	**6**	**Loss of mark for communication statement if incorrect science / terminology used** **e.g anterior pituitary rather than (posterior) pituitary / ADH secreted by adrenal gland** **OR give details of setting up a water potential gradient** **OR** **if no ref to homeostatic mechanism e.g. returning water potential of blood to normal value / ref to negative feedback** **Indicative scientific points may include:** ***Mechanism of ADH action*** • ADH targets / binds to cells of collecting duct • release of second messenger • vesicles with aquaporins fuse with plasma membrane • increase in permeability of collecting duct wall • more water moves down water potential gradient into cells ***Role of Receptors*** *Sensory receptors* • sensory receptors located in the hypothalamus • osmoreceptors • detect changes in osmotic pressure / water potential of blood • respond to effects of osmosis by shrinking or swelling *Receptors in collecting duct* • receptors located on cells of collecting duct ***(Posterior) pituitary*** • ADH made in hypothalamus • moves down axon to posterior pituitary
					• stored in vesicles • action potentials in neurosecretory cells • ADH released by posterior pituitary • by exocytosis • from neurosecretory cells
			Total	**16**	
Question			**Answer**	**Mark**	**Guidance**

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