Excretion

Model Answers 1

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Communication, homeostasis and energy
Торіс	Excretion
Booklet	Model Answers 1

Time allowed:	54 minutes
Score:	/40
Percentage:	/100
Grade Boundaries:	

A*	А	В	С	D	E
>69%	56%	50%	42%	34%	26%

Question 1

One treatment for thyroid cancer is radioactive iodine. The radioisotope I¹³¹ 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 I¹³¹, 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. I¹³¹ is very soluble in water.
- B. I¹³¹ is able to cross capillary walls.

C. The kidneys are more efficient at excreting I¹³¹ than the lungs.

D. The thyroid gland is well supplied with blood.

[1]

The kidneys produce urine which has the highest level of iodine whereas expired

air which is produced by the lungs has very little iodine

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.



Peritoneal dialysis involves fluid being introduced to the abdominal cavity, excretory products then diffuse through the membranes around the gut into the fluid which is eventually drained away

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Question 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

[1]

If hCG had a molecular mass greater than 69,00 it would stay in the blood and not be filtered

into the urine



Question 4

The process of ultrafiltration in the kidney shares similarities with the formation of tissue fluid.

- (a) * Describe the similarities and differences between ultrafiltration and the formation of tissue fluid. [6]
 - Small molecules leave the blood stream Capillaries are in a knot in UF but a network

in blood capillaries

Molecules not reabsorbed in UF become

urine, those not reabsorbed into capillaries

[4]

- Both processes occur in the capillaries
- Large molecules stay in the blood
 In UF the fluid passes through Bowmans Capsule
- Hydrostatic pressure is high in both
- Molecules are absorbed back into blood
- Hydrostatic pressure is higher than oncotic drain into lymph
- Basement membranes are involved
 Higher hydrostatic pressure in UF

You will see from the model answers that virtually any detail of the two processes gains a

mark. However both similarities and differences must be presented together for higher 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.

- Gender, as men have greater muscle mass
- Exercise/fitness as these individuals have greater muscle mass
- Age, as kidney function decreases as we get older
- Diet, as this will affect levels of creatine

Dr. Asher Rana 5 (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. [1]

Proteins are too large to leave the capillaries under normal circumstances

The basement membrane is a mesh of collagen that surrounds all capillaries. It is not a membrane made up of a phospholipid bilayer. The basement membrane determines what leaves the blood, basically any molecule with a molecular mass less than 69,000

[Total: 11]

<u>CHEMISTRY ONLINE</u> — TUITION — 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.

- (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.

[2]

10 8

Copeptin in saliva is 10¹ and C – reactive protein in the liver is 10⁹

This is an order of magnitude 10⁸

- (ii) Suggest why blood and faeces have the highest concentrations of C-reactive protein and copeptin.
 - The liver has a good blood supply
 - The liver secretes bile which contains the copeptin and C reactive protein

One of the many roles of the liver is the production of proteins, it also produces waste products which can be removed in the bile. Bile is removed in the faeces which explains why they contain such high concentrations of the two proteins

(b) Fig. 17.2 is an image of a Kupffer cell from the liver.



4µm

Fig. 17.2

[2]

(i) The diameter of the Kupffer cell in the image is 9.1 cm. Assuming it is spherical, calculate the actual volume of this cell.

[3] Give your answer to **four** significant figures. Show your working.

Measure the distance represented by $4\mu m$ and see how many times it goes into 9.1cm. It

should be about 4 and a half times, so the actual diameter is $18\mu m$ and the radius is $9\mu m$

The volume of a sphere is $4/3 \pi r^3$

1.33 x 3.14 x 9 x 9 x 9 = 3050. The actual mark scheme gives the answer as 3157 but this is

an image and not the same size as the one on the exam paper

- (ii) Which type of microscope has been used to obtain this image? Explain your answer. [2]
 - Its from an electron microscope
 - You can see organelles / it is high magnification / high resolution / 2D image

[Total: 9]

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The kidney is very important for the correct functioning of the body as it has a vital role in excretion.

(a) Define the term *excretion*.

[1]

• Excretion is the removal of waste products of metabolism

Waste products could include urea, water and carbon dioxide

(b) Fig. 2.1 is a diagram of the external view of a mammalian kidney. The diagram also shows the associated blood vessels and the ureter.



Table 2.1 lists some of the components of blood. Table 2.1 also shows the amount of each component in the renal vein compared with the renal artery.

The differences or similarities shown in Table 2.1 result from the blood passing through the kidney.

Complete Table 2.1 by providing an explanation for the difference or similarity in the amount of each component. The first explanation has been completed for you.

Component of blood	Amount in renal vein compared with that in renal artery	Explanation
Urea	Much less	When the blood enters the glomerulus, most of the urea gets filtered out of the blood. But some of it is reabsorbed as it goes through the nephron, so there is still a small amount in the renal vein.
lons	Slightly less	Most ions are reabsorbed but overall more are filtered than reabsorbed
Glucose	Slightly less	Most of the glucose is reabsorbed but some is used up by the kidney cells in respiration
Oxyhaemoglobin	Less	Oxygen is used by the kidney cells for aerobic respiration
Red blood cells	The same	Too large to be filtered out of the blood

Table 2.1

[4]

Molecules such as plasma proteins are too large to be filtered from the blood so they stay in the capillary and don't appear in the urine. Glucose and amino acids are filtered but all are reabsorbed, the only slight drop in glucose is the small amount used by the kidney to respire. Most ions like sodium and potassium are reabsorbed so a small amount appears in the urine and there is less in the renal vein. This question is really about the overall function of the kidney

(c) Anti-diuretic hormone (ADH) helps to regulate the water potential of the blood.

- (i) State where ADH is produced.
- Anti-diuretic hormone is produced in the hypothalamus or the neurosecretory cells that connect the hypothalamus to the pituitary gland
 Strictly speaking ADH is released from the posteriorly pituitary gland, but it is actually produced in the hypothalamus which lies just above the pituitary gland. Neurosecretory cells transport the ADH made in the hypothalamus to the posterior pituitary from where it is released
 - (ii) On which region of a kidney nephron are the ADH receptors found?

[1]

[1]

• ADH receptors are found in the cells of the collecting duct

ADH makes the cells of the collecting duct more permeable to water by stimulating them to create more channel proteins. Known as aquaporins, they allow the reabsorption of more water from the filtrate, producing a more concentrated urine whilst increasing the water potential of the blood

- (d) Drugs, known as diuretic drugs, are often given to patients with high blood pressure. Suggest how the action of these drugs results in a lowering of blood pressure.
- Diuretic drugs reduce the amount of water reabsorbed in the collecting duct from the filtrate
- If less water is reabsorbed then the volume of the blood will reduce which will decrease the blood pressure

[Total: 9]

[2]

The liver is an organ that is metabolically very active, carrying out over 500 different functions. Some of its important functions include converting chemicals including toxins, into other compounds.

Fig. 2.1 outlines some of the reaction pathways that take place in the liver cells.

The *underlined words* represent toxic compounds.



(a) (i) State the product of the ornithine cycle in Pathway P and the organ to which this product is transported for removal from the body.
 [2]

product urea

organ the product is transported to kidney

(ii) The lactate that enters pathway **S** is produced by cells, such as muscle cells, undergoing anaerobic respiration.

Suggest why this lactate is converted into pyruvate by the hepatocytes (liver cells) rather than by the respiring cells in which it is produced.

- The hepatocytes can tolerate much lower pH caused by the build-up of lactic acid
- [1]
- Hepatocytes have the enzymes to metabolise lactic acid and catalyse this reaction

whereas other cells in the body do not

• Conversion of lactic acid requires oxygen and muscle cells in this condition do not

have enough oxygen; they are undergoing anaerobic respiration where oxygen is not

available

(b) Insulin only remains in the bloodstream for a relatively short time. Pathway **R** breaks down insulin in the liver.

Explain what might happen to a person if the liver did not break down insulin.

• If the liver did not break down insulin then blood glucose concentration would fall below

normal levels

- Glucose would continue to be taken up by muscle and other cells for respiration
- Under the influence of insulin the liver would continue to convert this into glycogen
- This may lead eventually to a coma or death

Sometimes questions are not as straightforward as you would like. However, if you fully

understand the role of the liver and homeostasis you can apply this to unfamiliar situations.

Try rephrasing the question to 'What is the relationship between insulin and glucose?'

- (c) Alcohol (ethanol) is oxidised in the liver by Pathway **Q**. If a person has a high alcohol intake, it will result in the production of excess reduced NAD.
 - (i) Excess reduced NAD in the liver cells will influence some metabolic pathways by:
 - inhibiting the conversion of lactate to pyruvate
 - inhibiting fatty acid oxidation
 - promoting fatty acid synthesis.

Using this information **and** the information in Fig. 2.1, suggest the consequences for **liver metabolism** if a person has a regular high alcohol intake.

• With a regular high alcohol intake there would be a build-up of lactate which would

eventually poison the liver cells

- Enzymes would be disrupted or denatured as a result of the low pH
- Fatty acids would not be available for respiration
- There would be less NAD for such metabolic reactions
- The build-up of fatty acids would result in more fat deposits in the liver cells leading to

fatty liver and eventually cirrhosis

Use the information in the given text to answer this question

[2]

[2]

(ii) State **precisely** where in the liver cell the excess reduced NAD can be re-oxidised. [1]



Crista or inner mitochondrial membrane

[Total: 8]

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