

14.1 Homeostasis in Mammals

Question Paper

Course	CIEA Level Biology
Section	14. Homeostasis
Topic	14.1 Homeostasis in Mammals
Difficulty	Hard

Time allowed: 50
Score: /37
Percentage: /100

Question 1a

Describe how the structure of the nephron and its associated blood vessels are adapted to the process of ultrafiltration.

[8 marks]

Question 1b

Describe the effects of insulin on its main target tissues and explain how this leads to changes in blood glucose concentration.

[7 marks]

Question 2a

Insulin is a hormone that affects blood sugar levels.

Explain how insulin affects body cells.

[3 marks]

Question 2b

Diabetes is a condition in which the hormone insulin is unable to carry out its function. Metformin is a drug sometimes used to treat diabetes.

A research group investigated the effect of metformin on blood glucose levels in 10 diabetic mice. The mice were given no food for 12 hours and were then given either no metformin (the control group), a 60 mg per kg dose of metformin, or a 400 mg per kg dose. 30 minutes later the mice were given a glucose meal and 180 minutes after this their blood glucose levels were measured. The results, along with bars to show standard deviation, are shown in Fig. 1.

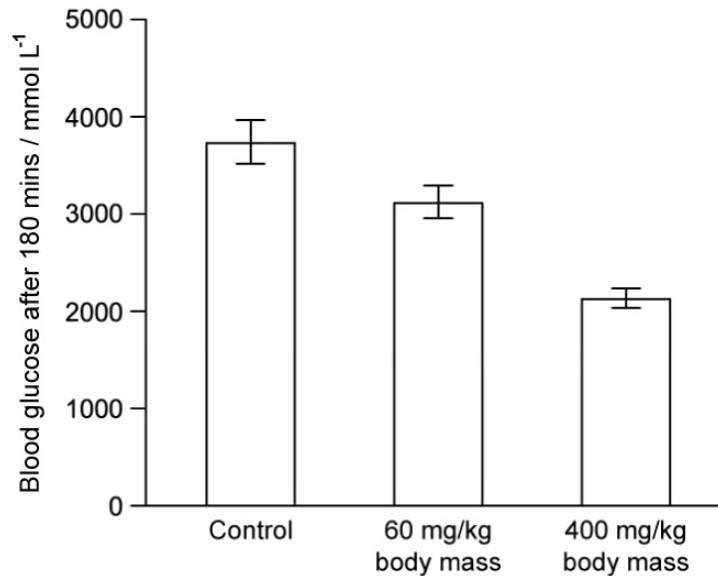


Fig. 1

A research assistant concluded from these results that metformin was an effective drug for the treatment of diabetes in human patients.

Use Fig. 1 and the information provided to evaluate this conclusion.

[3 marks]

Question 2c

The drug metformin works by lowering cellular levels of cyclic AMP.

Suggest how metformin works to reduce the impact of non-functioning insulin.

[3 marks]

Question 2d

A simple indicator test for diabetes in a patient involves the use of a urine test strip.

(i)

State why urine test strips show the presence of glucose but not other sugars in the urine.

[1]

(ii)

Explain why glucose is present in the urine of diabetic individuals.

[1]

[2 marks]

Question 3a

Fig. 1 shows the changing concentrations of several substances as they pass through the regions of the nephron.

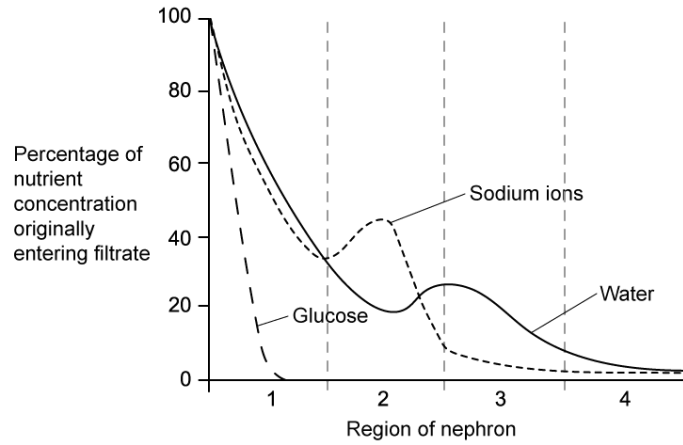


Fig. 1

(i)
Identify region 1 of the nephron shown in Fig. 1.

[1]

(ii)
Give a reason for your answer to part (i).

[1]

[2 marks]

Question 3b

Region 2 in Fig. 1 is the location at which much of the water is reabsorbed from the filtrate. During the second half of region 2, sodium ions are actively pumped out of the nephron into the surrounding medulla, indicated by a downward curve in Fig. 1.

Suggest how this accounts for the reabsorption of water from region 2.

[2 marks]

Question 3c

Fig. 2 shows a micrograph of the lining of region 1 from Fig. 1.

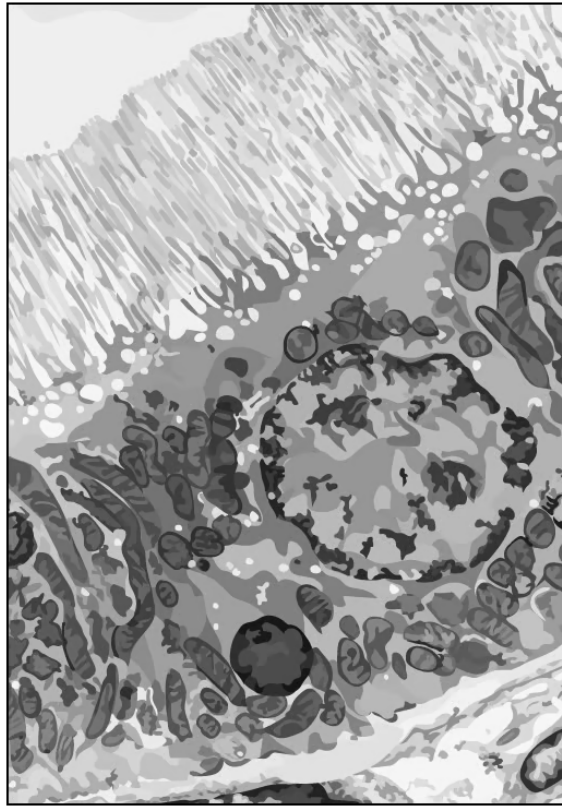


Fig. 2

(i)
Identify **two** features visible in Fig. 2 that aid the process of reabsorption.

[2]

(ii)
Explain how each of the features identified in part (i) aid reabsorption.

[2]

[4 marks]

Question 3d

The cells shown in Fig. 2 have many Na^+/K^+ transporter proteins in their cell surface membranes.

Explain the role of Na^+/K^+ transporter proteins in the reabsorption of nutrients.

[3 marks]