14. Homeostasis

14.1 Homeostasis in Mammals

Paper 4

Question Paper

1 Osmoregulation is the control of the water potential of body fluids such as blood.

(a) Osmoreceptors and antidiuretic hormone (ADH) have an important role in osmoregulation.

(i) Name the location of osmoreceptors.

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(ii) State the stimulus that is detected by osmoreceptors.

..... [1]

(iii) Name the structure that secretes ADH into the blood.

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(b) ADH acts on the cells of the collecting duct, resulting in changes in the volume and concentration of urine.

Fig. 1.1 shows the relationship between the concentration of ADH in the blood and the rate of production of urine by the kidneys.

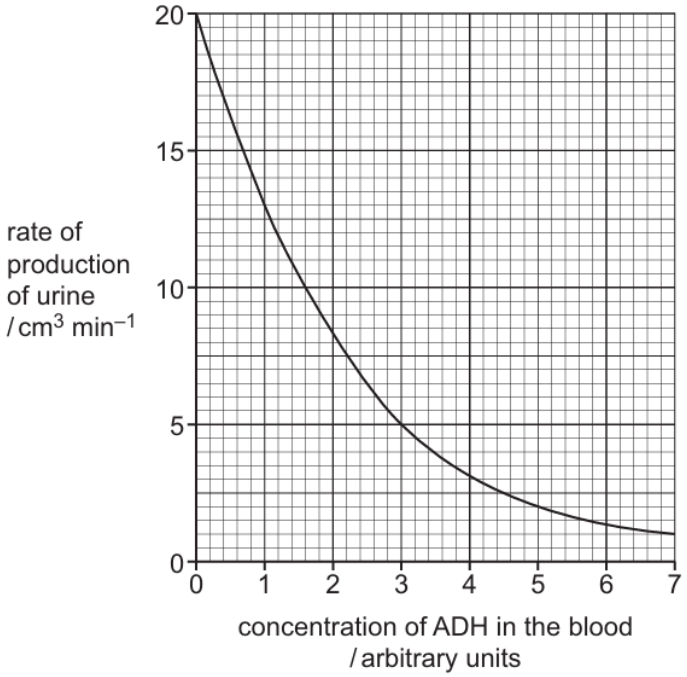


Fig. 1.1

(i) As the concentration of ADH in the blood increases, the rate of production of urine decreases.

Using Fig. 1.1, calculate the percentage decrease in the rate of production of urine between ADH concentrations of 1 and 3 arbitrary units.

Show your working.

Give your answer to **one** decimal place.

answer = ... [2]

(ii) Explain the relationship shown in Fig. 1.1.

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2 **(a)** In mammals, blood glucose concentration is maintained around a set point so that the mammal can function efficiently. This is an example of homeostasis.

Name the mechanism that maintains blood glucose concentration around a set point.

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(b) Fig. 10.1 shows how the blood glucose concentration varies before, during and after a period of exercise.

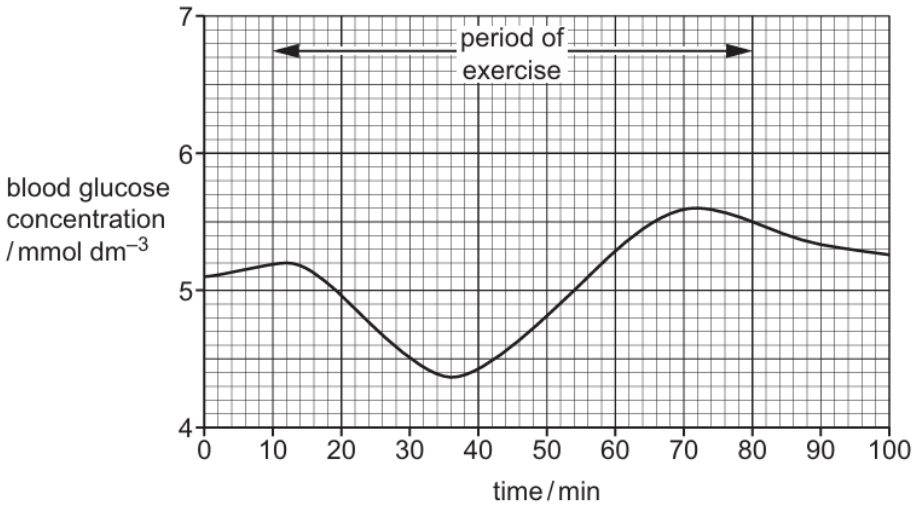


Fig. 10.1

Explain the results shown in Fig. 10.1 between 15 minutes and 70 minutes.

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(c) Type 1 diabetes in humans is a condition where the pancreas does not produce enough insulin to control blood glucose concentration.

Test strips are used to measure the concentration of glucose in a sample of urine. Two reactions take place on the test strip and a colour change occurs if glucose is present in the urine.

The equations for these reactions are:

$$\text{glucose} + \text{oxygen} \xrightarrow{\text{glucose oxidase}} \mathbf{A} + \text{hydrogen peroxide}$$

$$\text{hydrogen peroxide} + \mathbf{B} \xrightarrow{\text{peroxidase}} \text{oxidised } \mathbf{B} + \text{water}$$

(i) Identify compound **A** and the type of substrate represented by **B**.

A .....

B .....

[2]

(ii) Most people with diabetes mellitus use a biosensor to obtain their blood glucose concentration.

Suggest the advantages of using a biosensor rather than test strips.

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3 **(a)** Fig. 1.1 is a diagram of part of a Bowman's capsule and a glomerular capillary.

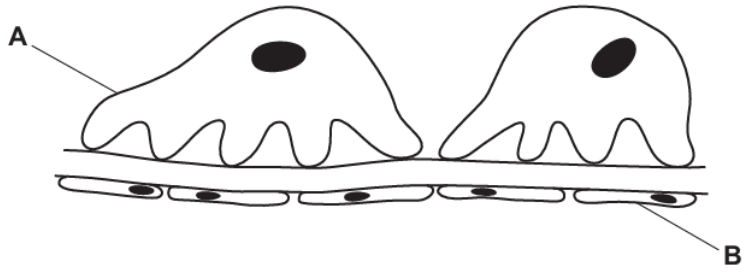


Fig. 1.1

(i) Identify structures **A** and **B**.

A .....

B .....
[2]

(ii) The glomerular filtrate is produced in the Bowman's capsule by the process of ultrafiltration.

State the conditions required for ultrafiltration.

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..... [2]

(b) As the newly formed glomerular filtrate passes along the proximal convoluted tubule, selective reabsorption takes place. The fluid remaining in the proximal convoluted tubule eventually forms urine.

Table 1.1 lists three of the components of blood plasma that enter the glomerulus in a healthy person.

Complete Table 1.1 by writing:

- **increased**, if the component is present and is higher in concentration than in blood plasma
- **decreased**, if the component is present and is lower in concentration than in blood plasma
- **same**, if the component is present and is of the same concentration as blood plasma
- **not present**, if the component is absent.

You may use each response once, more than once or not at all.

Table 1.1

component of blood plasma entering glomerulus	component in newly formed glomerular filtrate	component in urine
glucose		
large plasma proteins		
urea		

[3]

(c) Sweating during exercise can lead to a response in the posterior pituitary gland and in the kidney.

State the response to sweating that occurs in the posterior pituitary gland **and** the response that occurs in the kidney.

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..... [2]

4 **(a)** Blood glucose concentration is maintained around a set point by homeostasis.

Explain the principles of homeostasis.

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(b) Glycogen phosphorylase catalyses the conversion of glycogen to glucose in liver cells. The production of glycogen phosphorylase is coded for by the gene *PYGL*.

A mutation in *PYGL* leads to a condition called glycogen storage disease type VI (GSDVI), in which glycogen is not broken down efficiently.

Suggest **and** explain why cell signalling by glucagon is likely to be affected in the liver cells of a person with GSDVI.

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(c) Glycogen synthase catalyses the conversion of glucose to glycogen in liver cells. The production of glycogen synthase is coded for by the gene *GYS2*.

A mutation in *GYS2* leads to a condition called glycogen storage disease type 0 (GSD0) in which glycogen is not formed efficiently.

Suggest what the consequences would be if a person with GSD0 has a meal rich in glucose.

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..... [3]

5 The mammalian kidney is responsible for:

- the excretion of urea
- osmoregulation (the homeostatic control of the water potential of the blood).

(a) (i) Outline how **and** where the excretory product urea is made in the body.

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..... [2]

(ii) Homeostatic control of the water potential of blood includes receptors, effectors and target cells.

Identify the names **and** locations of these components of homeostatic control in osmoregulation.

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..... [3]

(b) The glomerulus and Bowman's capsule of the nephron are important in the formation of urine.

Outline the role of the glomerulus and Bowman's capsule in the formation of urine.

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..... [3]

(c) Concentrated urine contains a high concentration of solutes and a small volume of water. Different species of mammals vary in their ability to produce urine with a high solute concentration.

Table 6.1 compares the ratio of the solute concentration of urine (U) to the solute concentration of blood plasma (P) in some mammal species. The habitats of the mammal species are also shown.

Table 6.1

mammal species	maximum ratio of solute concentration of urine to solute concentration of blood plasma (U : P)	habitat
beaver	1.7 : 1	rivers and lakes
human	4.5 : 1	variable
camel	8.0 : 1	desert
rat	9.0 : 1	variable
kangaroo rat	16.0 : 1	desert

With reference to Table 6.1, suggest what the different values of U : P show about the ability of these mammal species to tolerate a shortage of water in their environment.

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6 **(a)** Fig. 6.1 is a photomicrograph of a section through a Bowman's capsule and a glomerulus.

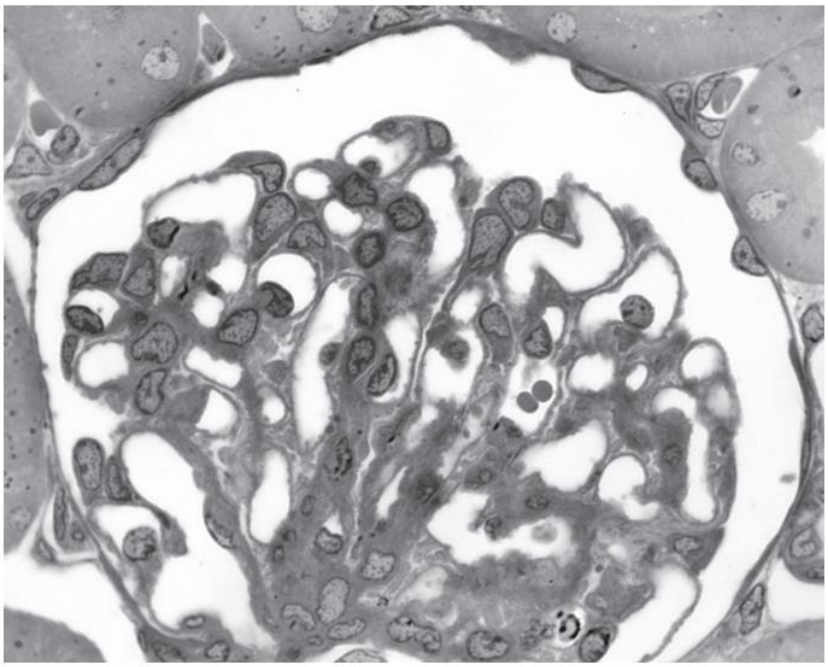


Fig. 6.1

On Fig. 6.1, use label lines and letters to label:

F – the location of the glomerular filtrate

P – the location of the blood plasma. [2]

(b) The glomerular filtration rate (GFR) is the rate at which fluid filters from the blood in the glomerulus into the Bowman's capsule.

Fig. 6.2 shows the mean GFR values for healthy males and females of different age groups.

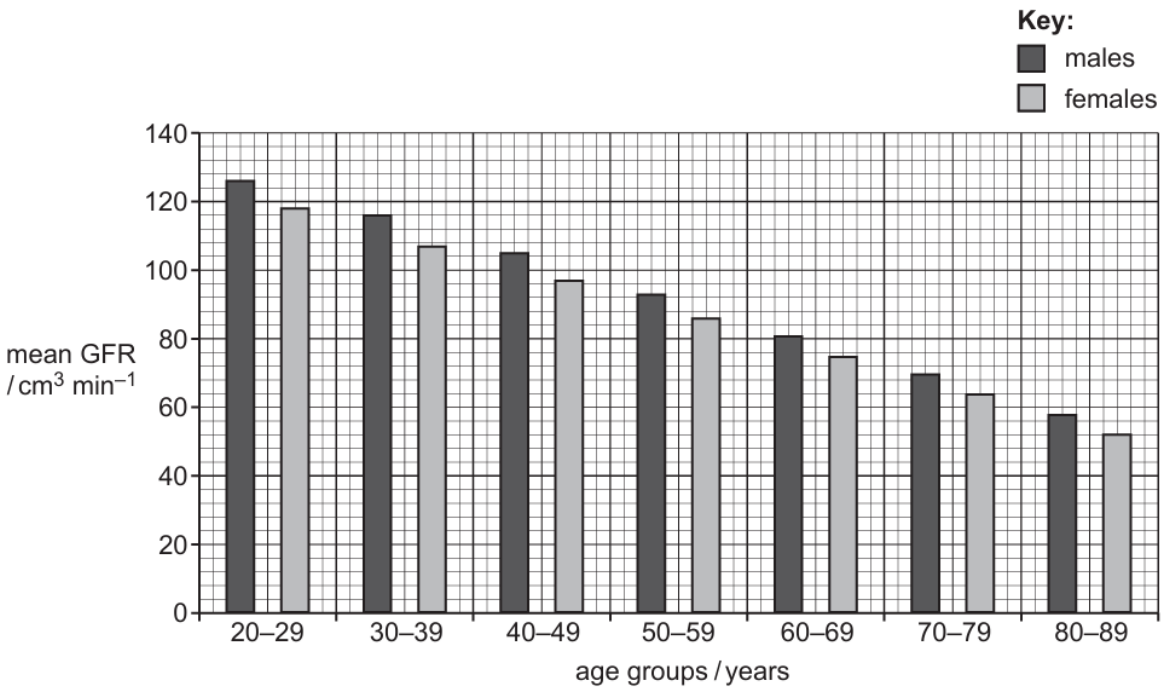


Fig. 6.2

(i) Use Fig. 6.2 to calculate the yearly rate of decrease in mean GFR from the 20–29 age group to the 80–89 age group for **females**.

Show your working.

Give your answer to **one** decimal place and include units.

answer ..... [3]

(ii) The age of a person and whether they are male or female can affect GFR.

Suggest **and** explain other factors that can affect GFR.

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(c) The glomerular filtrate passes from the Bowman's capsule to the proximal convoluted tubule, where selective reabsorption takes place.

Describe the process of selective reabsorption.

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7 **(a)** The passage outlines the endocrine system.

Complete the passage by using the most appropriate scientific terms.

The endocrine system consists of tissues and ..... , which secrete hormones such as insulin, glucagon and antidiuretic hormone (ADH). Glucagon only affects target cells that have complementary receptors, which are located on the ..... . Glucagon binds to these receptors and this leads to the production of a ..... , which transfers the signal throughout the cytoplasm. The target cells for insulin are in the liver, ... and adipose tissue. The target cells for ADH are those of the distal convoluted tubule and the ..... of the kidney nephron. These hormones are involved in ..... , which is the maintenance of a constant internal environment. [6]

(b) The blood glucose concentration of a person was measured at regular intervals after the ingestion of a meal rich in glucose.

Fig. 9.1 shows the results of this investigation.

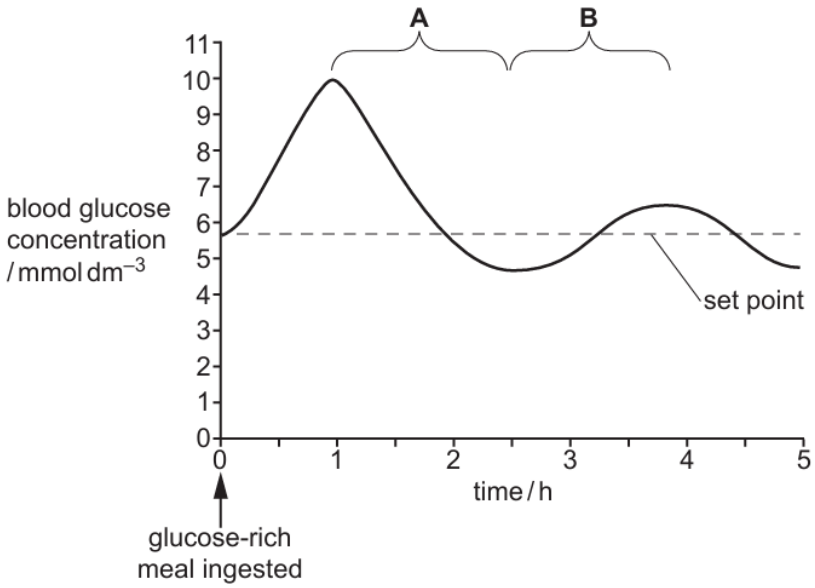


Fig. 9.1

(i) Explain how the blood glucose concentration is reduced during phase **A** of the curve.

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..... [3]

(ii) Suggest why the blood glucose concentration increases again during phase **B**.

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8 The kidney is an important organ of homeostasis. One role of the kidney is osmoregulation.

(a) Fig. 5.1 is a photomicrograph of part of a kidney nephron.

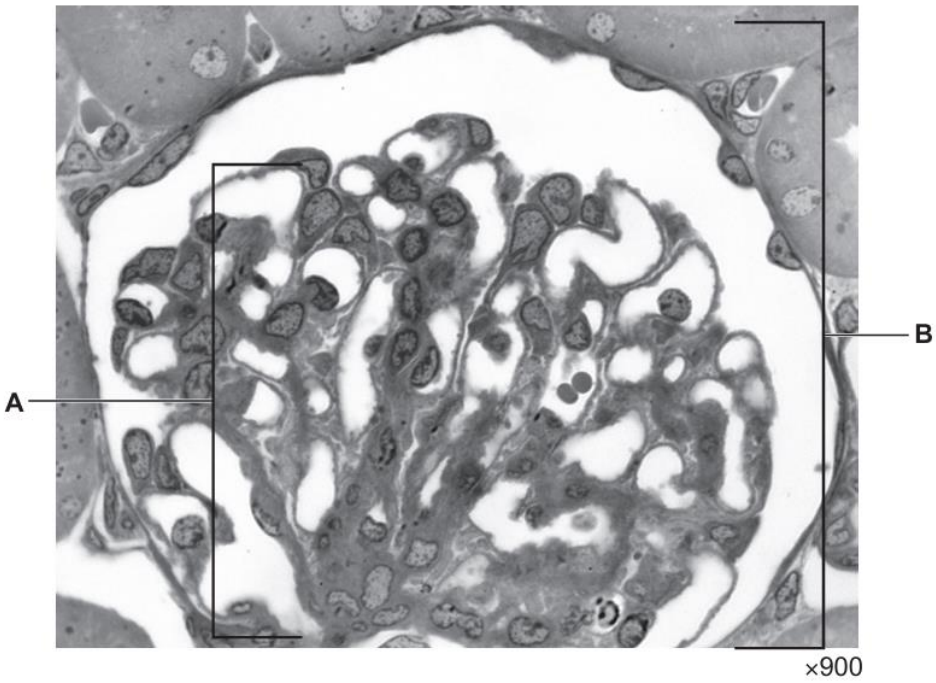


Fig. 5.1

(i) Identify the structures labelled **A** and **B** in Fig. 5.1.

A .....

B .....
[2]

(ii) Describe how blood is filtered by the part of the kidney nephron shown in Fig. 5.1.

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..... [4]

(b) The cell surface membranes of kidney cells have receptors for many molecules, including glucagon and antidiuretic hormone (ADH).

(i) Glucagon binds to G-protein-coupled receptors on kidney cells.

The binding of glucagon to kidney cells activates a cell signalling pathway that is similar to the cell signalling pathway activated when glucagon binds to liver cells.

Fig. 5.2 is an outline of the cell signalling pathway activated when glucagon binds to kidney cells.

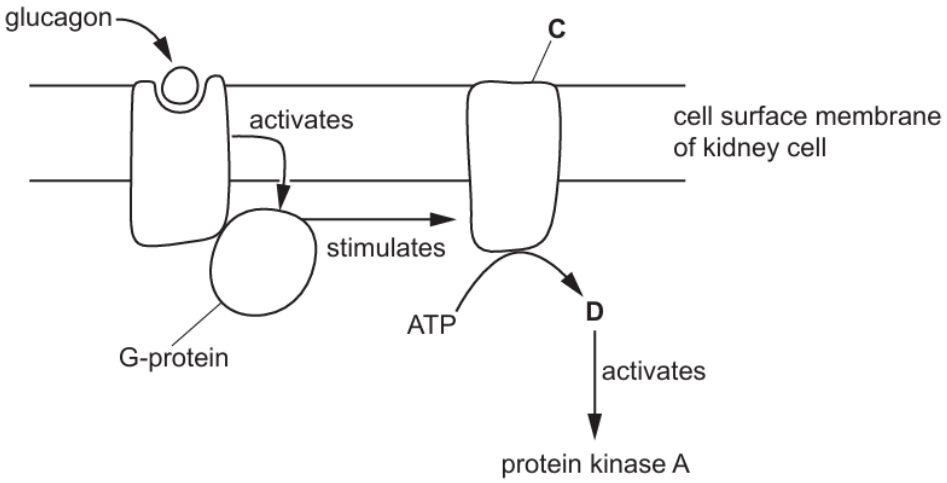


Fig. 5.2

Name the molecules labelled **C** and **D** in Fig. 5.2.

C .....

D .....

[2]

(ii) Syndrome of inappropriate antidiuresis (SIAD) is a condition that affects osmoregulation in the kidney.

Fig. 5.3 shows how sodium ion concentration in the blood affects the ADH concentration in the blood in:

- people with normal homeostasis
- people with one type of SIAD, known as type C SIAD.

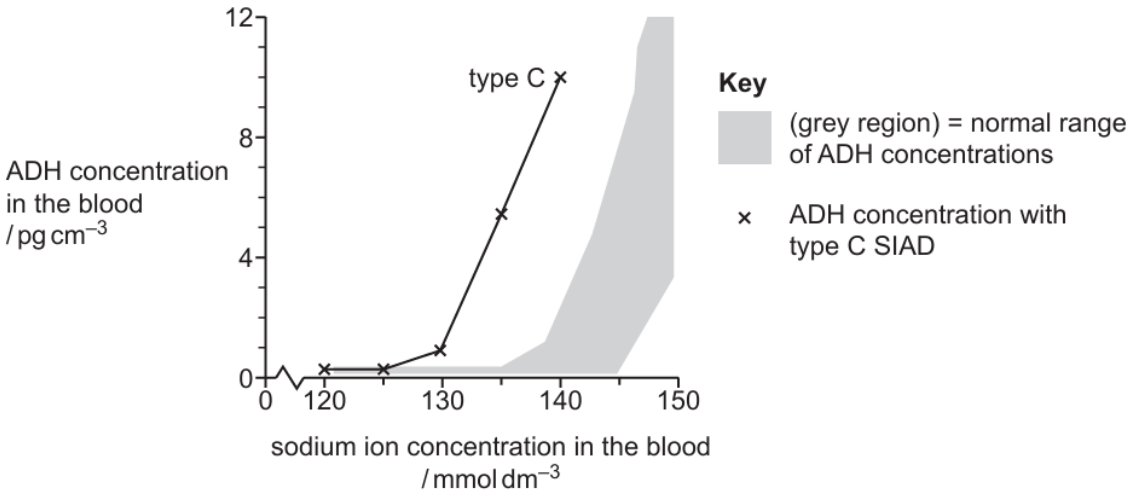


Fig. 5.3

Describe the results shown in Fig. 5.3 **and** explain the effect of type C SIAD on osmoregulation.

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9 **(a)** **(i)** When blood glucose concentration decreases, glucagon is released by the pancreas into the blood and is transported to the cells.

Fig. 6.1 outlines the effect of glucagon on liver cells.

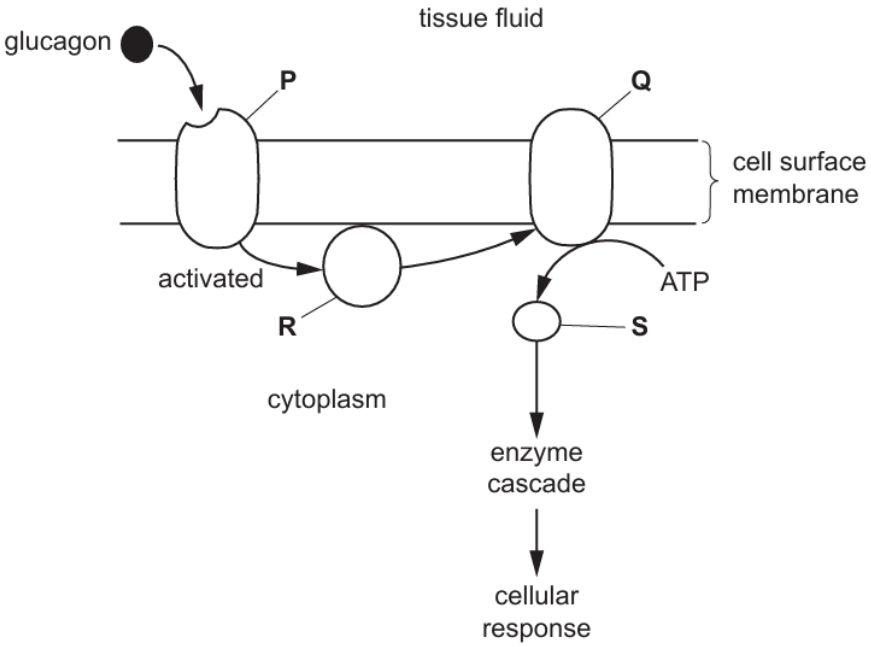


Fig. 6.1

Identify **P**, **Q**, **R** and **S** shown in Fig. 6.1.

P .....

Q .....

R .....

S .....

[4]

(ii) Table 6.1 shows four processes carried out by liver cells that are affected by a decrease in blood glucose concentration. Some of these are cellular responses from cell signalling by glucagon.

Complete Table 6.1 by stating whether the rate of each process **increases** or **decreases** when blood glucose concentration decreases.

Table 6.1

process	effect on rate of process when blood glucose concentration decreases
glycogenolysis (glycogen breakdown)	.....
glycogenesis (glycogen formation)	.....
glycolysis	.....
fatty acid synthesis	.....

[3]

(b) Type 2 diabetes is a condition affecting the homeostatic control of blood glucose concentration. In type 2 diabetes, target cells have a much lower response to insulin and some glucose is excreted in the urine.

Test strips can be used to measure the concentration of glucose in a sample of urine, but many people with type 2 diabetes measure blood glucose concentration using a biosensor.

Explain the principles of operation of a test strip for glucose **and** suggest advantages for a person with type 2 diabetes of using a biosensor instead of a test strip.

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..... [7]

10 **(a)** Antidiuretic hormone (ADH) is involved in the maintenance of a constant blood water potential.

A student drank 0.5 dm^3 of water and the concentration of ADH in their blood was measured every 30 minutes for 3 hours.

Fig. 9.1 shows the results of this investigation.

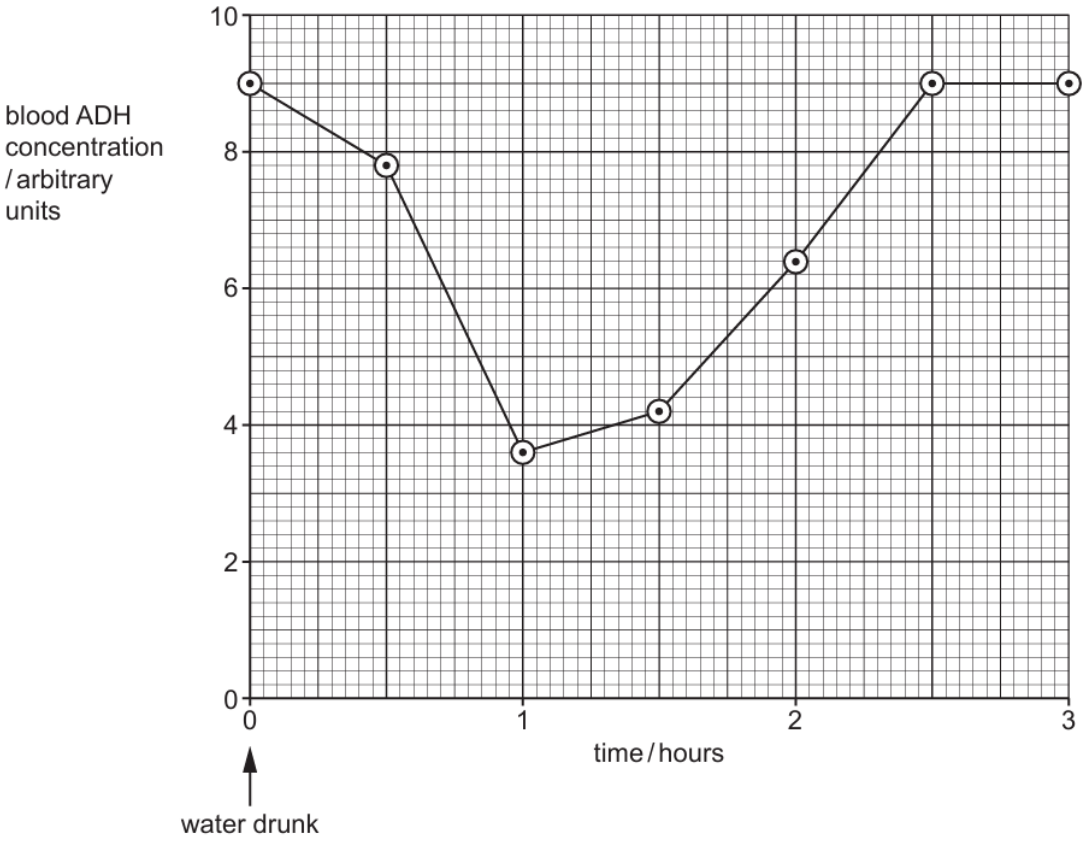


Fig. 9.1

Explain the results shown in Fig. 9.1.

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..... [4]

11 When an impulse arrives at a neuromuscular junction, it stimulates a muscle fibre of striated muscle to contract.

(b) Adrenaline is a hormone that can affect muscle contraction. Adrenaline binds to G-protein-coupled receptors on T-tubule membranes.

The cell signalling pathway that occurs in response to the binding of adrenaline is similar to the pathway that occurs in liver cells in response to the binding of glucagon.

Fig. 7.1 is an outline of the cell signalling pathway of adrenaline.

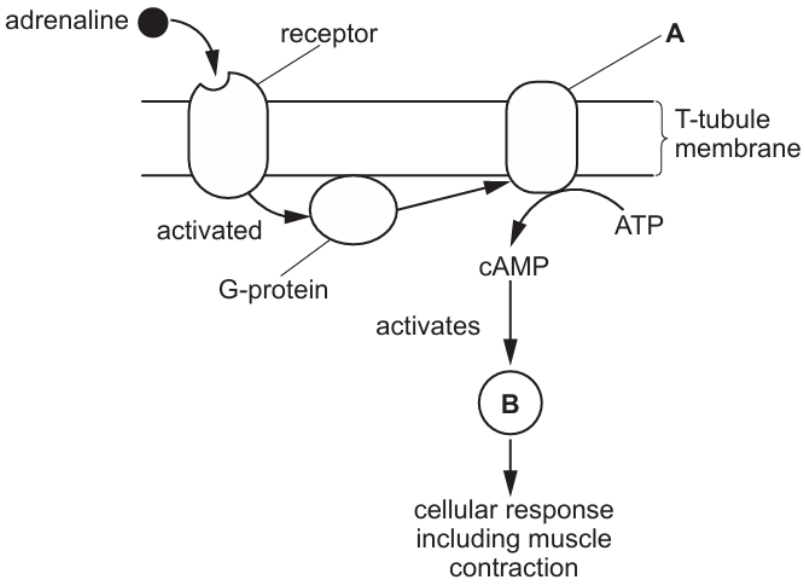


Fig. 7.1

Identify the molecules represented by **A** and **B** in Fig. 7.1.

A .....

B ..... [2]

12 **(a)** Fig. 8.1 is a diagram of a kidney nephron.

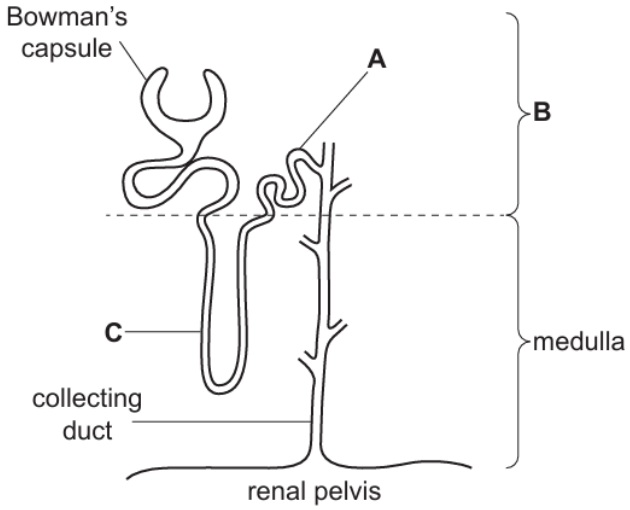


Fig. 8.1

With reference to Fig. 8.1, name **A**, **B** and **C**.

A .....

B .....

C .....

[3]

(b) Antidiuretic hormone (ADH) is involved in the maintenance of the water potential of the blood.

Fig. 8.2 shows the relationship between blood ADH concentration, urine concentration and the flow rate of urine.

The flow rate of urine is the rate of production of urine by the kidneys.

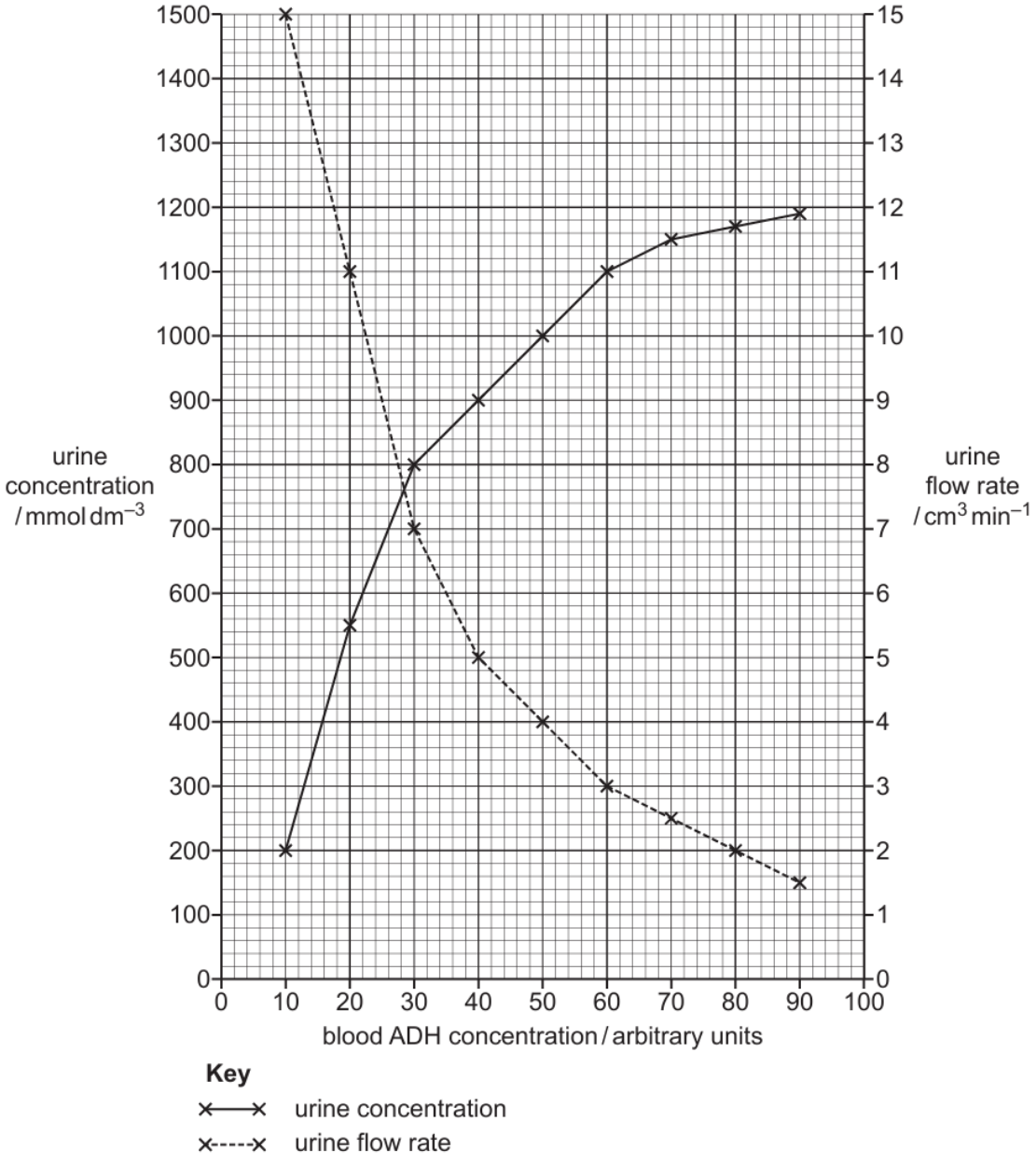


Fig. 8.2

Describe the relationships shown in Fig. 8.2.

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..... [3]

(c) Describe **and** explain the action of ADH on the cells of the collecting duct when the water potential of the blood decreases.

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..... [5]

13 The passage below outlines homeostasis.

Complete the passage by using the most appropriate scientific terms.

Homeostasis, in mammals, is the process of keeping the ..... environment of the body in optimum conditions so that cells can function efficiently. Blood water potential, core temperature and blood glucose concentration are all factors that need to be kept at optimum values or set-point.

When a condition deviates from its set-point, a corrective mechanism is triggered. An increase in blood glucose concentration triggers processes to decrease it and vice versa. This corrective mechanism is called ..... .

The pancreas is involved in the control of blood glucose concentration. Glucose binds to ..... on the cell surface membrane of pancreatic cells. These are ..... cells, which secrete hormones such as insulin and glucagon. The two hormones have opposite effects on the blood glucose concentration. For example the action of one hormone stimulates the uptake of glucose by cells for respiration and the action of the other hormone stimulates the breakdown of ..... to glucose in the liver.

14 **(a)** In mammals, the blood glucose concentration must be maintained within narrow limits so that the body cells can function efficiently.

Name the mechanism by which the blood glucose concentration is maintained within narrow limits.

..... [1]

(b) Glucagon is released by the alpha (α) cells of the pancreas when the blood glucose concentration decreases below the set point.

Fig. 6.1 outlines the response of liver cells to glucagon.

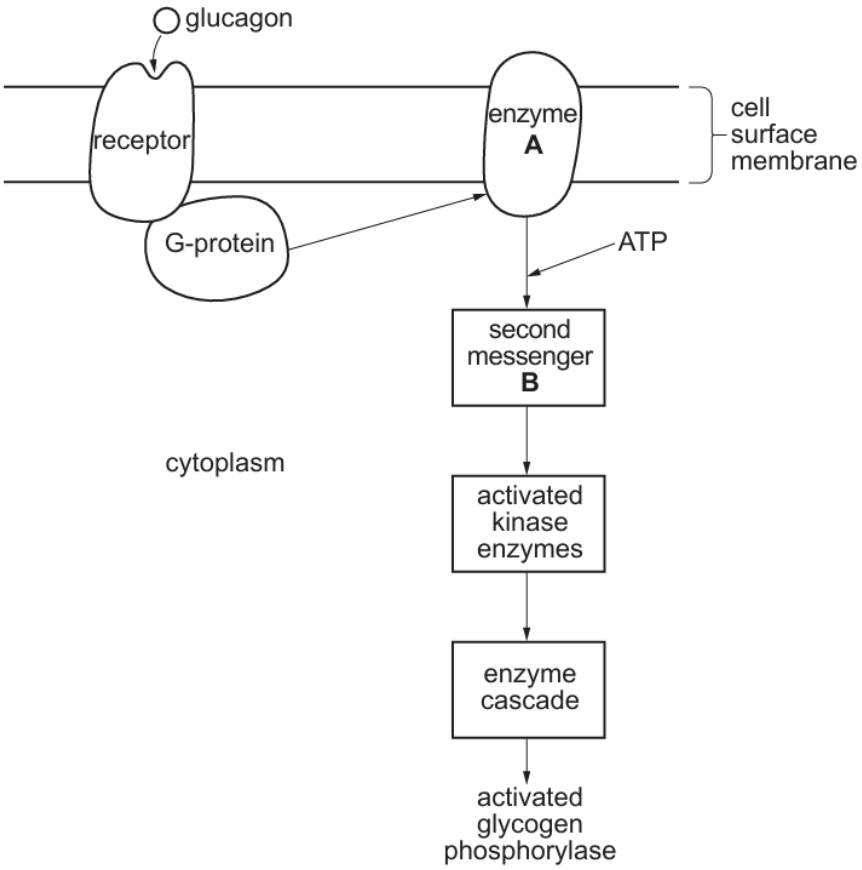


Fig. 6.1

(i) State how glucagon reaches the liver cells.

..... [1]

(ii) With reference to Fig. 6.1, name enzyme **A** and second messenger **B**.

A .....

B .....

[2]

(iii) State the role of the enzyme cascade.

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..... [1]

(iv) State the function of the final enzyme in the pathway, glycogen phosphorylase.

..... [1]

(c) A biosensor is used to measure blood glucose concentration to check that it is within the normal range.

Describe how a glucose biosensor works.

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..... [4]

15 **(a)** Ultrafiltration in the kidney takes place between the glomerulus and the Bowman's capsule. The afferent blood vessel carrying blood to the glomerulus has a wider lumen than the efferent blood vessel.

Explain why the lumen of the afferent blood vessel needs to be wider than the lumen of the efferent blood vessel.

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..... [2]

(b) Fig. 9.1 is a diagram of part of the glomerulus and Bowman's capsule.

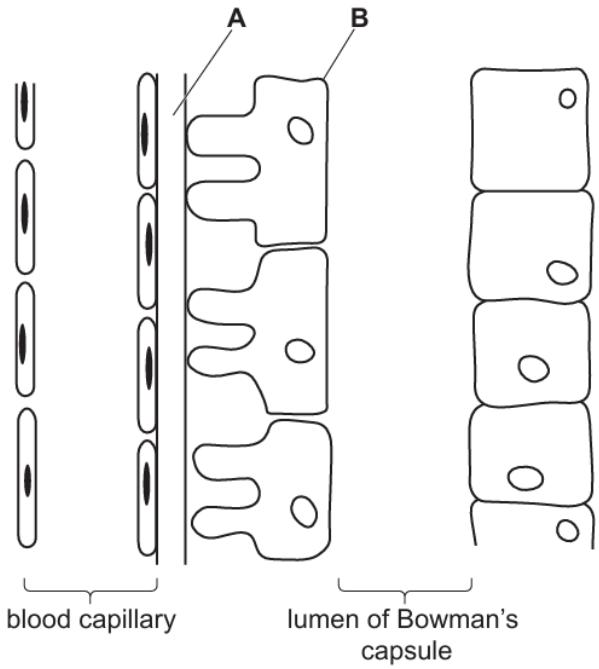


Fig. 9.1

(i) Name **A** and **B**.

A .....

B .....

[2]

(ii) Describe the roles of **A** and **B** in the formation of the glomerular filtrate.

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..... [3]

16 Glucagon-like peptide-1 (GLP-1) is a hormone consisting of 31 amino acids. It is secreted by specialised intestinal epithelial cells known as L cells.

Fig. 6.1 outlines the secretion of GLP-1 and its effects on the pancreas, brain and stomach.

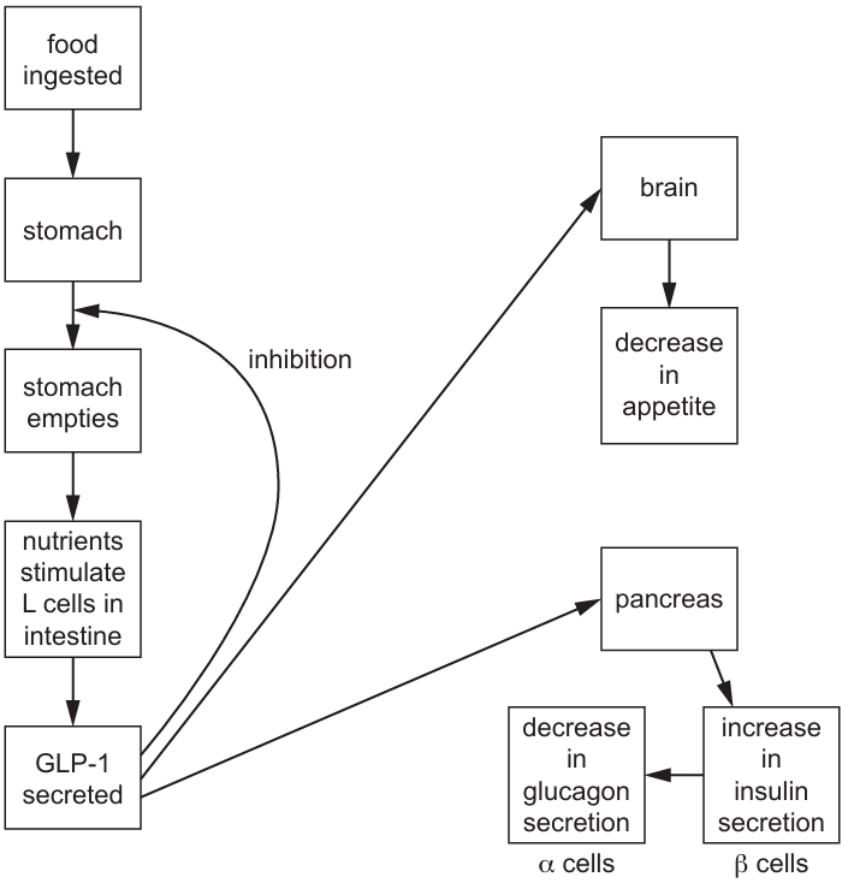


Fig. 6.1

(b) GLP-1 inhibits the secretion of glucagon by α cells in the pancreas.

Describe **two** processes in the liver that are stimulated by glucagon.

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..... [2]

(d) GLP-1 inhibits the emptying of the stomach. This is an example of negative feedback.

Explain what is meant by negative feedback.

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..... [3]

17 **(a)** Thermoregulation is the control of the core temperature of the body.

Thermoreceptors send information about a change in core temperature to the hypothalamus. The hypothalamus controls the core temperature by sending impulses to activate several physiological responses.

Table 6.1 lists physiological responses to a **decrease** in core temperature.

Complete Table 6.1 to explain how each response contributes to maintaining a core temperature within narrow limits.

Table 6.1

response	explanation
blood vessels near the surface of the skin constrict (narrow)	....
shivering occurs	....
hairs rise	....
reduction in the production of sweat	....

[4]

(b) Animals can also use behaviour to adapt to temperature changes.

Suggest why some animals curl up their bodies in cold weather.

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..... [1]

(c) The Sitatunga deer, *Tragelaphus spekii*, and the Nile monitor lizard, *Varanus niloticus*, live in Africa.

Fig. 6.1 shows a Sitatunga and Fig. 6.2 shows a Nile monitor.



Fig. 6.1



Fig. 6.2

An investigation was carried out to measure the core temperature of the Sitatunga and the Nile monitor as the environmental temperature was increased.

The results are shown in Fig. 6.3.

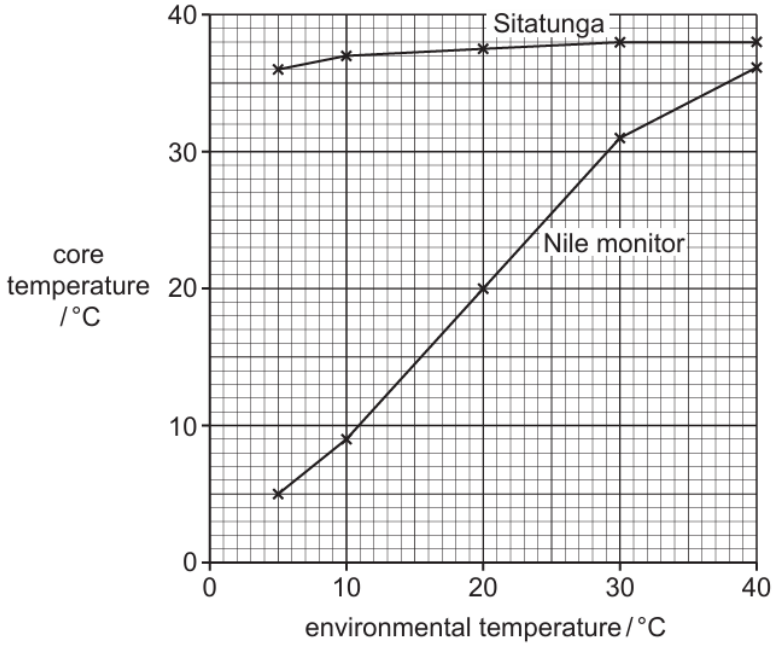


Fig. 6.3

(i) Describe the results shown in Fig. 6.3.

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(ii) When the environmental temperature is low, Nile monitors are relatively inactive.

Suggest **one** disadvantage to the Nile monitor of being inactive.

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(d) Thermoregulation relies on negative feedback.

Explain what is meant by negative feedback.

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..... [3]

18 **(a)** The enzyme alanine transaminase (ALT) is found in the liver. The function of ALT is to convert the amino acid α-ketoglutarate into another amino acid, glutamate.

Suggest why the liver may need to convert one amino acid into another.

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..... [1]

(c) ALT can leak into the blood from liver tumour cells.

An increase in the concentration of ALT in the blood causes a decrease in the water potential of the blood.

State precisely the name **and** location of the cells where a change in the water potential of the blood would be detected.

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..... [1]

(d) Describe the homeostatic role of ADH when the water potential of the blood **decreases**.

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..... [5]

19 **(a)** The Bowman's capsule of a nephron is involved in ultrafiltration.

Fig. 1.1 is a diagram of part of a Bowman's capsule and glomerulus.

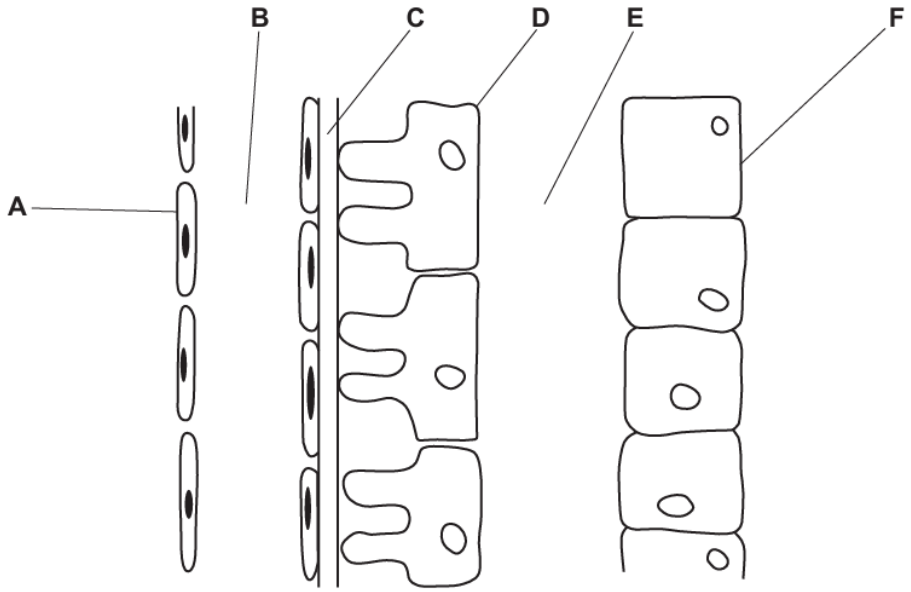


Fig. 1.1

With reference to Fig. 1.1, complete Table 1.1 using the letters **A** – **F**.

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

Table 1.1

feature	letter
glomerular filtrate	.....
basement membrane	.....
podocyte cell	.....
capillary endothelial cell	.....

[4]

(b) Describe **and** explain how the structures in the Bowman's capsule and its associated blood supply are adapted to allow ultrafiltration to take place.

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..... [5]

(c) The glomerular filtration rate (GFR) is the rate at which blood plasma is filtered in the Bowman's capsule.

Fig. 1.2 shows the relationship between GFR and mean renal arterial blood pressure.

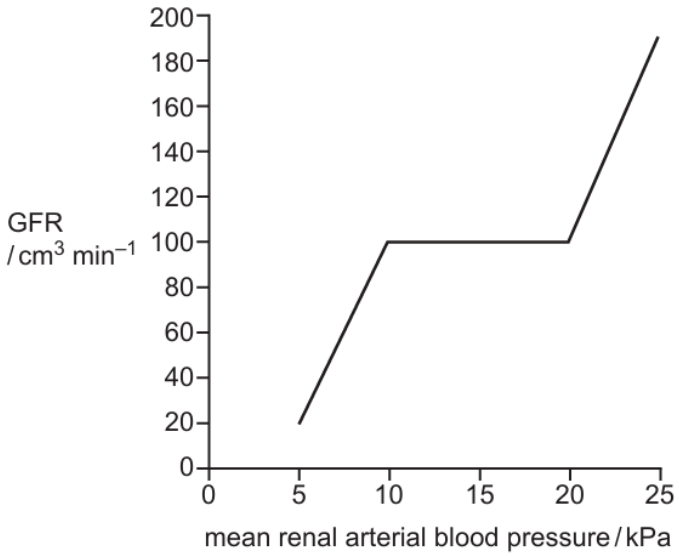


Fig. 1.2

(i) Comment on the relationship between GFR and mean renal arterial blood pressure.

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..... [2]

(ii) Suggest **one** reason why the GFR of a person might decrease.

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..... [1]

20 **(a)** Thyrotoxic myopathy (TM) is a neuromuscular disorder caused by overproduction of the thyroid hormone thyroxine. One of the main symptoms of TM is muscle fatigue.

Fig. 6.1 outlines the effects of overproduction of thyroxine on striated muscle.

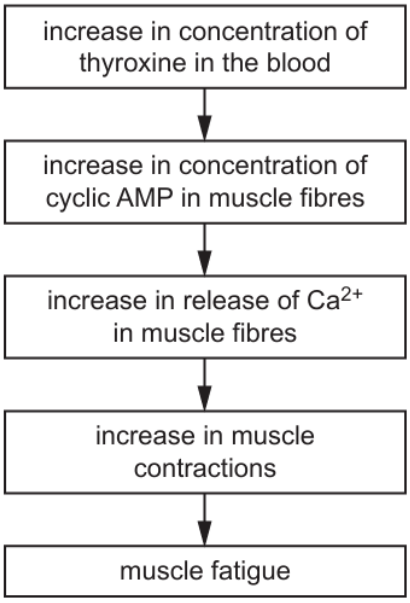


Fig. 6.1

(i) The concentration of thyroxine in the blood usually fluctuates around a set point.

Name the mechanism that keeps the concentration of thyroxine in the blood close to its set point.

..... [1]

(ii) Name the part of the striated muscle fibre that releases Ca^{2+}.

..... [1]

(iii) Describe the role of Ca^{2+}, troponin and tropomyosin in the contraction of striated muscle.

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..... [4]

(iv) Cyclic AMP (cAMP) is also involved in the response of liver cells to glucagon.

Describe the role of cAMP in the response of liver cells to glucagon.

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.....

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..... [2]

(b) An increase in the concentration of thyroxine in the blood can lead to a condition called insulin resistance (IR). IR decreases the sensitivity to insulin of target cells, such as muscle and liver cells.

Suggest how decreased sensitivity to insulin affects target cells.

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..... [3]

21 **(a)** Fig. 1.1 is a diagram of a kidney nephron and some of its blood vessels.

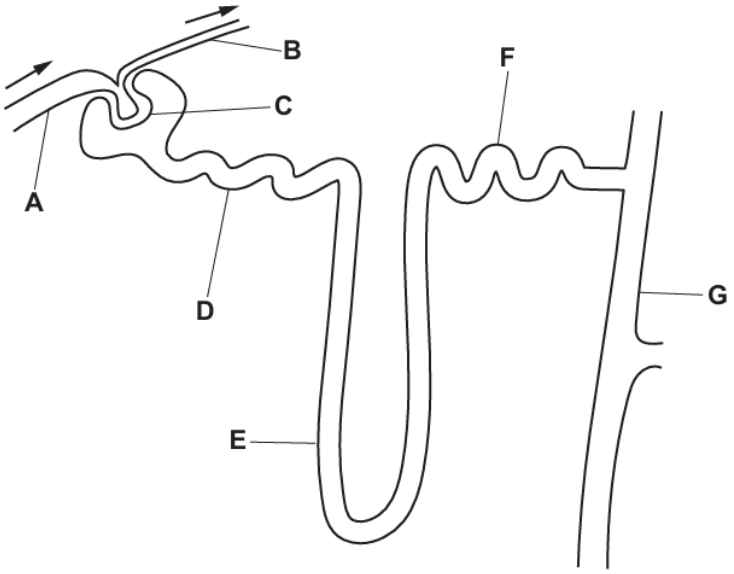


Fig. 1.1

With reference to Fig. 1.1, complete Table 1.1 using the letters **A** – **G**.

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

Table 1.1

description	letter
efferent blood vessel	.....
part of nephron containing cells that respond to ADH	.....
part of nephron where podocyte cells are located	.....
part of nephron containing cells that are located in the medulla	.....

[4]

(b) Describe **and** explain how the cells of the proximal convoluted tubule are adapted to carry out selective reabsorption.

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..... [5]

(c) Fig. 1.2 shows the concentrations of ADH in the blood at different percentage changes in water potential of the blood.

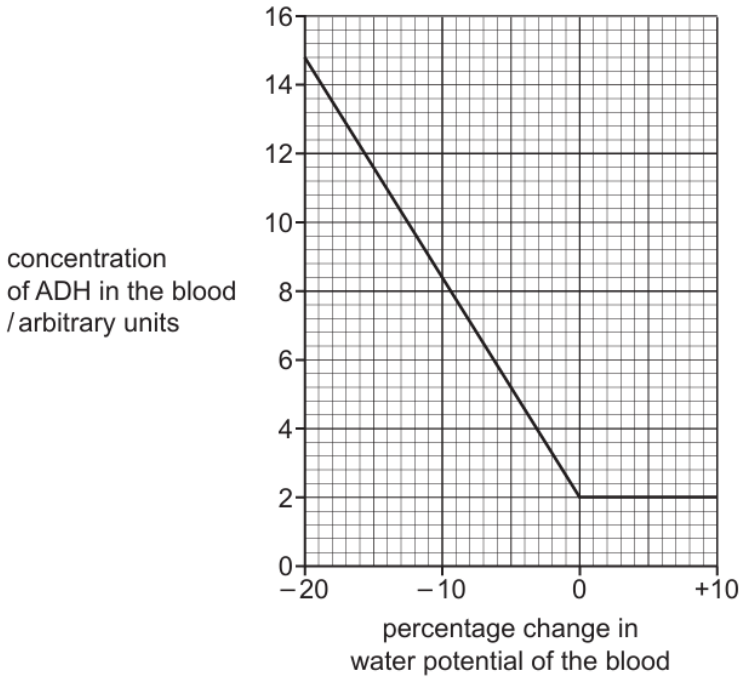


Fig. 1.2

(i) Describe the trend shown in Fig. 1.2.

.....

.....

.....

.....

.....

..... [2]

(ii) Sometimes a person will have a low concentration of ADH in the blood even though there is a change in the water potential.

Suggest **one** effect on the circulatory system of a low concentration of ADH in the blood.

.....

.....

..... [1]

22 **(a)** In mammals, the hormone ACTH is released from the anterior pituitary gland. ACTH stimulates the cells of the adrenal glands to synthesise the hormone cortisol. This is an example of cell signalling.

The main stages of cell signalling involving ACTH are similar to the main stages of cell signalling by adrenaline.

Describe the main stages of cell signalling involving ACTH.

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..... [5]

(b) If the concentration of cortisol in the blood increases above its set point, it will inhibit the production of ACTH by the anterior pituitary gland.

Name this type of homeostatic mechanism.

..... [1]

(d) One symptom of Cushing's disease in a dog is that the dog will want to drink much more than normal.

Suggest **one other** reason why a dog would want to drink much more than normal.

.....

..... [1]

23 Insulin is transported around the body in the blood. The cells of the liver, muscle tissue and adipose (fat) tissue have receptors for insulin.

(a) State:
- the precise cellular location of the insulin receptors
- the type of biological molecule that forms an insulin receptor.

location .....

type of biological molecule .....
[2]

(b) Insulin stimulates the activity of the enzyme glycogen synthetase in liver cells.

Fig. 7.1 shows the activity of glycogen synthetase in liver cells for 210 seconds after glucose has been injected into the bloodstream.

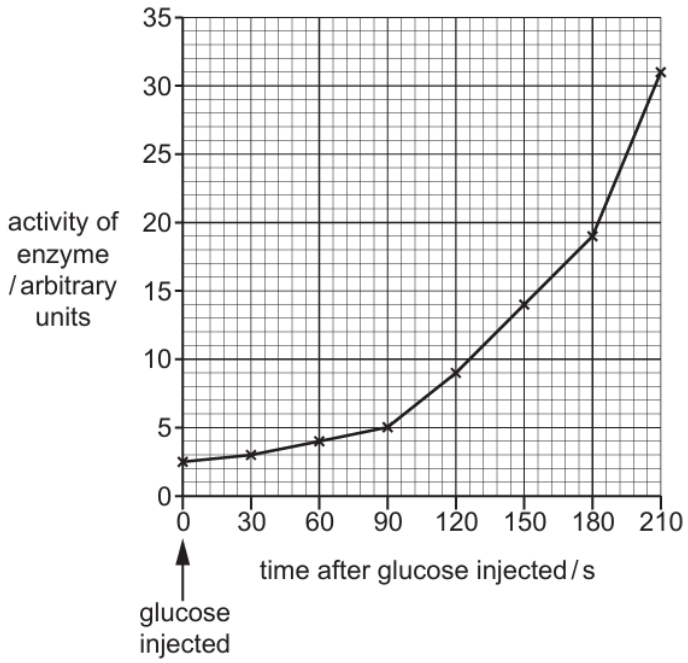


Fig. 7.1

(i) Calculate the percentage increase in glycogen synthetase activity between 90 s and 180 s after glucose was injected into the blood.

Show your working and write your answer to the nearest whole number.

answer .....% [2]

(ii) Suggest the role of glycogen synthetase in the regulation of blood glucose concentration.

.....

..... [1]

24 **(a)** ADH is a hormone that is released into the blood of a mammal when changes occur in the internal environment.

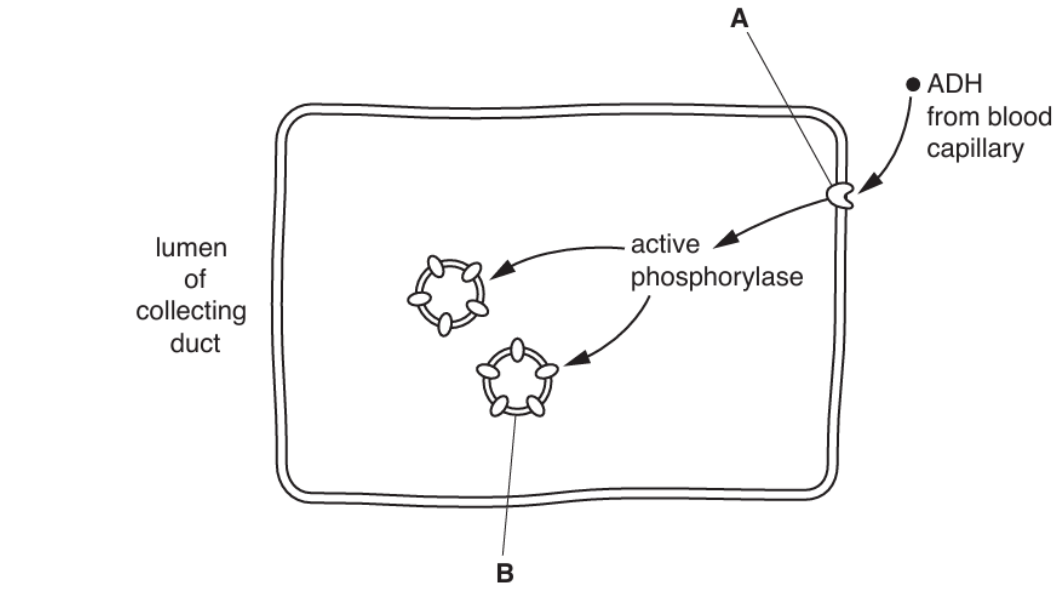
(i) State **one** change in the internal environment of a mammal that leads to the release of ADH.

..... [1]

(ii) Name the part of the body that releases ADH into the blood.

..... [1]

(b) Fig. 1.1 shows a cell of one of the collecting ducts of the kidney.



not to scale

Fig. 1.1

Name membrane protein **A** and cell structure **B**.

A .....

B ..... [2]

(c) The phosphorylase enzyme stimulates structure **B**.

Describe the response of structure **B** to this stimulation **and** describe the consequences of this response.

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..... [4]

25 **(a)** Fig. 5.1 is a photomicrograph of part of the cortex of a kidney.

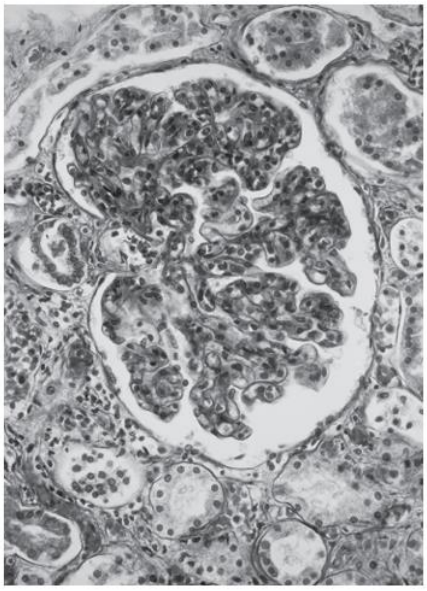


Fig. 5.1

(i) On Fig. 5.1, use label lines and letters to label:

G – the glomerulus

L – the lumen of the Bowman's (renal) capsule.

[2]

(ii) During ultrafiltration, components of blood in the glomerulus with a relative molecular mass greater than 68 000 are prevented from passing into the Bowman's capsule.

Name the structure that acts as this filtration barrier.

..... [1]

(b) The glomerular filtration rate (GFR) is the rate of flow of filtered fluid through the kidneys per unit time.

The afferent arterioles supply blood to the glomerulus of each nephron within the kidney and the efferent arterioles take blood away from each glomerulus. The lumen diameters of the afferent and efferent arterioles have a large effect on the GFR. Normally the lumen diameters of the afferent and efferent arterioles are different, but they can change to increase or decrease the normal GFR in response to changing conditions.

Complete Table 5.1 to indicate whether the GFR is normal, increased, or decreased for each combination of arteriole diameters shown.

The first row has been completed for you.

Table 5.1

afferent arteriole lumen diameter	efferent arteriole lumen diameter	GFR
normal	normal	normal
decreased	normal	.....
normal	increased	.....

[2]

(c) After leaving the Bowman's capsule, the glomerular filtrate passes through the proximal convoluted tubule, where selective reabsorption occurs.

Describe **and** explain how all of the glucose in the glomerular filtrate is reabsorbed back into the blood.

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..... [5]

(d) State **and** explain **three** features of a proximal convoluted tubule cell that adapt it to its function.

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..... [3]

26 **(a)** Some people have a condition called diabetes. In type 1 diabetes the pancreas does not produce enough insulin.

Fig. 7.1 shows the blood glucose concentrations of a type 1 diabetic person and a non-diabetic person, at regular intervals after drinking a glucose drink.

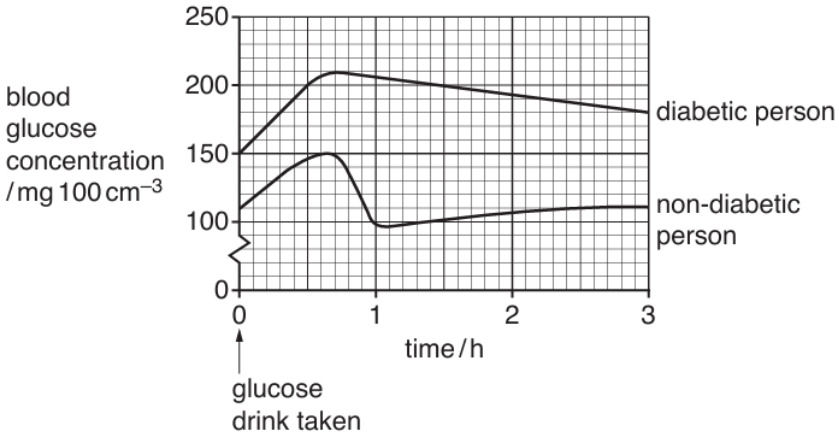


Fig. 7.1

(i) Describe the results shown in Fig. 7.1.

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.....

..... [3]

(ii) Name the location of the receptors in a non-diabetic person that detect a change in blood glucose concentration.

..... [1]

(iii) Name the homeostatic mechanism by which blood glucose concentration is maintained.

..... [1]

(b) The urine of a non-diabetic person does not contain glucose. A person with type 1 diabetes will excrete glucose in urine.

A reading of the concentration of glucose in the urine can be estimated using a dipstick.

Fig. 7.2 outlines how a dipstick works.

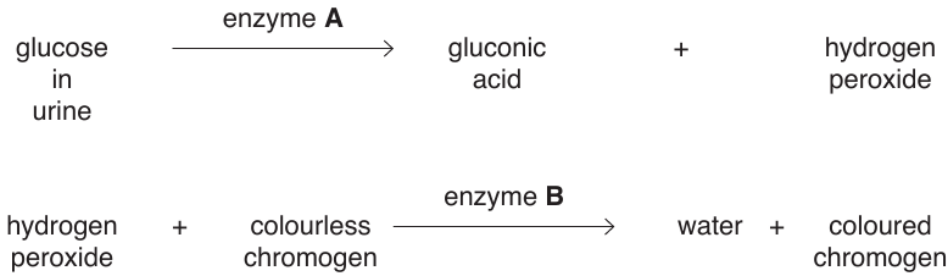


Fig. 7.2

The higher the concentration of glucose in the urine, the darker the colour on the dipstick.

(i) Name enzymes **A** and **B**.

A .....

B .....

[2]

(ii) An electronic biosensor can be used to measure the glucose concentration in a drop of blood.

Suggest **one** advantage of using a biosensor and **one** advantage of using a dipstick to measure glucose concentration.

biosensor .....

.....

dipstick .....

.....

[2]

(c) Describe the role played by insulin in the control of blood glucose concentration.

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..... [5]