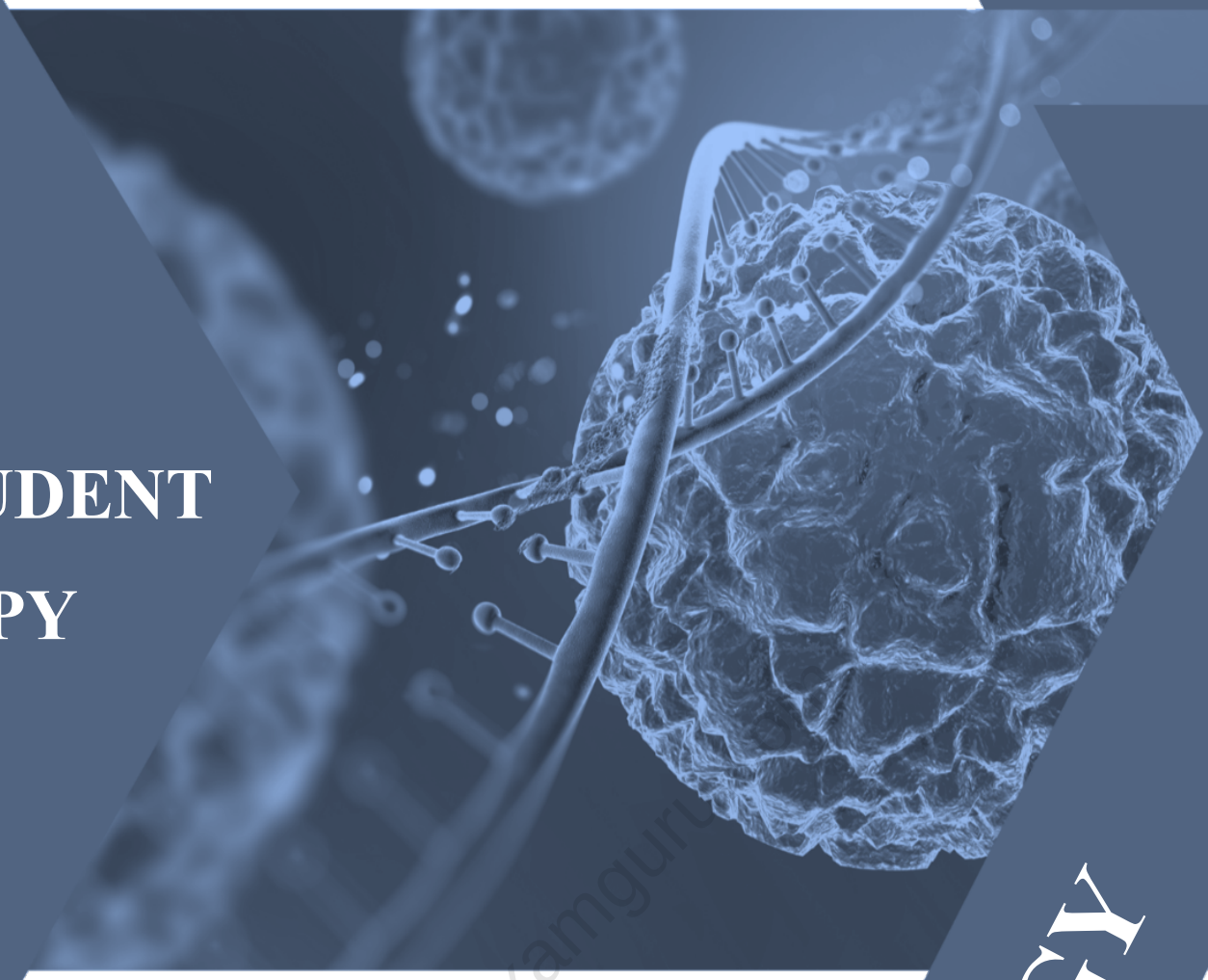


STUDENT COPY

HEADS-UP
REACH FOR THE STARS

IGCSE BIOLOGY

TOPICAL PRACTICE QUESTIONS

PAPER 4

VOL. 3

2020 EDITION

CHAPTERS 13-15

Chapter 13: Excretion in Humans

1 (a) Define the term *excretion*.

.....

.....

.....

.....

..... [3]

Fig. 2.1 shows a kidney tubule and the blood vessels associated with it.

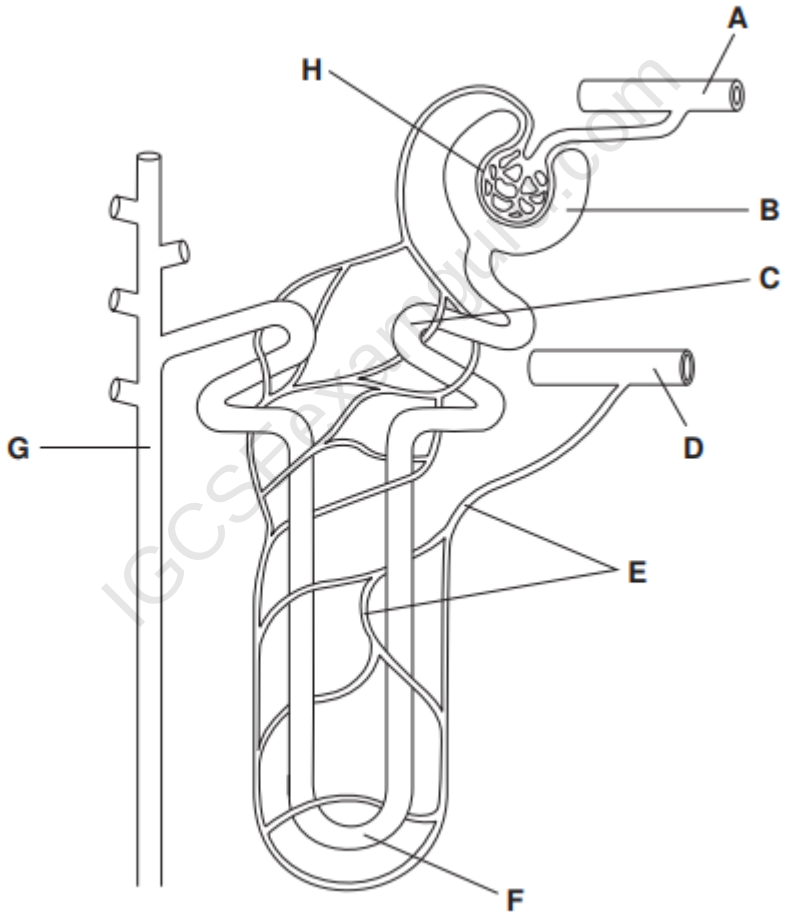


Fig. 2.1

(b) Table 2.1 shows some processes that occur in a kidney.

In Table 2.1, write the **letter** of the part shown in Fig. 2.1 where each process occurs.

You must put **one** letter in each box. You may use the same letter more than once.

Table 2.1

process	letter
filtration of blood	
reabsorption of most of the solutes from the filtrate	
water is absorbed by osmosis to determine the concentration of urine	
unfiltered blood returns to the renal vein	

[4]

(c) Table 2.2 lists the components of blood, filtrate and urine.

Table 2.2

component	blood	filtrate	urine
red blood cells	✓	×	×
white blood cells	✓		
plasma proteins	✓		
glucose	✓		
urea	✓		
salts	✓		
water	✓		

Complete the table by using ticks (✓) and crosses (×) to show whether or not each component is present in filtrate and in urine of a healthy person. The first component has been done for you. [2]

[Total: 9]

2 The kidneys remove metabolic waste from the liquid part of the blood.

Name:

(i) the liquid part of the blood;

..... [1]

(ii) the process that involves removing metabolic waste from the body.

..... [1]

Fig. 1.1 shows a kidney tubule and its associated blood vessels.

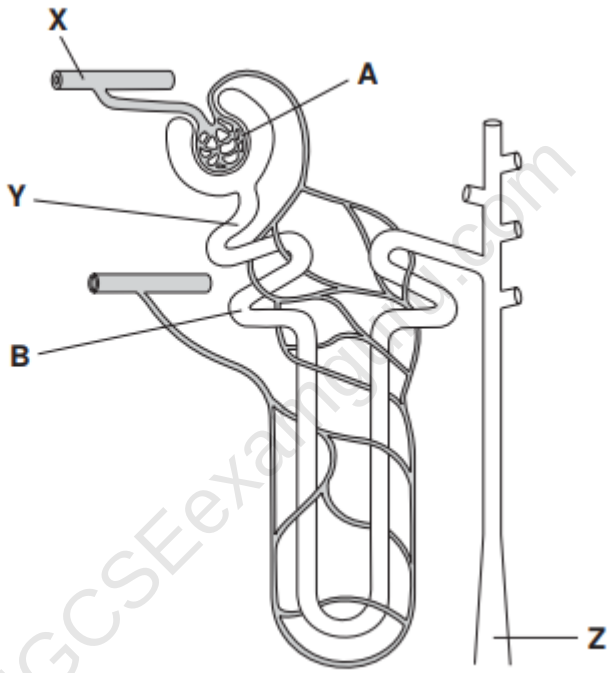


Fig. 1.1

(b) Describe the functions of the regions labelled **A** and **B**.

A .....

.....

.....

B .....

.....

..... [4]

Table 1.1 shows the concentrations of some substances in the blood at **X**, the fluid at **Y** and the urine at **Z**.

Table 1.1

substance	concentration / g per 100 cm^3		
	blood at **X**	fluid at **Y**	urine at **Z**
glucose	0.1	0.1	0.0
protein	7	0	0
sodium ions	0.35	0.35	0.5
urea	0.03	0.03	2.0

(c) Name the substance shown in Table 1.1 that:

(i) has molecules that are too large to pass through the walls of capillaries;

..... [1]

(ii) is all reabsorbed in the kidney;

..... [1]

(iii) is a metabolic waste product.

..... [1]

(d) Explain why the concentrations of sodium ions and urea are greater at **Z** than at **Y**.

.....

.....

.....

..... [2]

(e) People who have acute kidney failure are given dialysis treatment.

In dialysis machines, the blood flows through narrow tubes made from partially permeable membranes, surrounded by dialysis fluid.

(i) Dialysis fluid contains sodium ions.

Use the information in Table 1.1 to suggest the concentration of sodium ions that should be in the fluid and give a reason for your answer.

concentration ..... g per 100 cm^3

reason .....

.....

..... [2]

(ii) State **two** components of blood that are **not** in dialysis fluid.

1 .....

2 ..... [2]

(f) Heparin is added to the blood before it returns to the body from the dialysis machine. Heparin prevents a person's blood from clotting.

Describe the process of blood clotting.

.....

.....

.....

.....

.....

..... [3]

[Total: 18]

3 Fig. 3.1 shows a vertical section of a kidney.

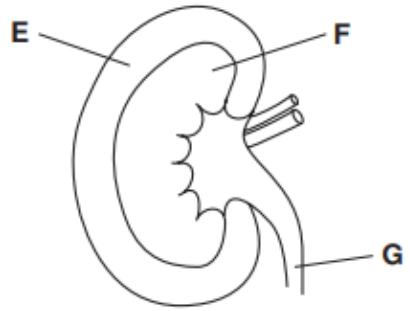


Fig. 3.1

(a) Name the parts **E**, **F** and **G**.

E .....

F .....

G ..... [3]

(b) Substances move into and out of cells in kidney tubules.

Fig. 3.2 shows four processes, **H**, **J**, **K** and **L**, that occur in cells lining the kidney tubule.

The net movement of substance is shown by an arrow, in each case.

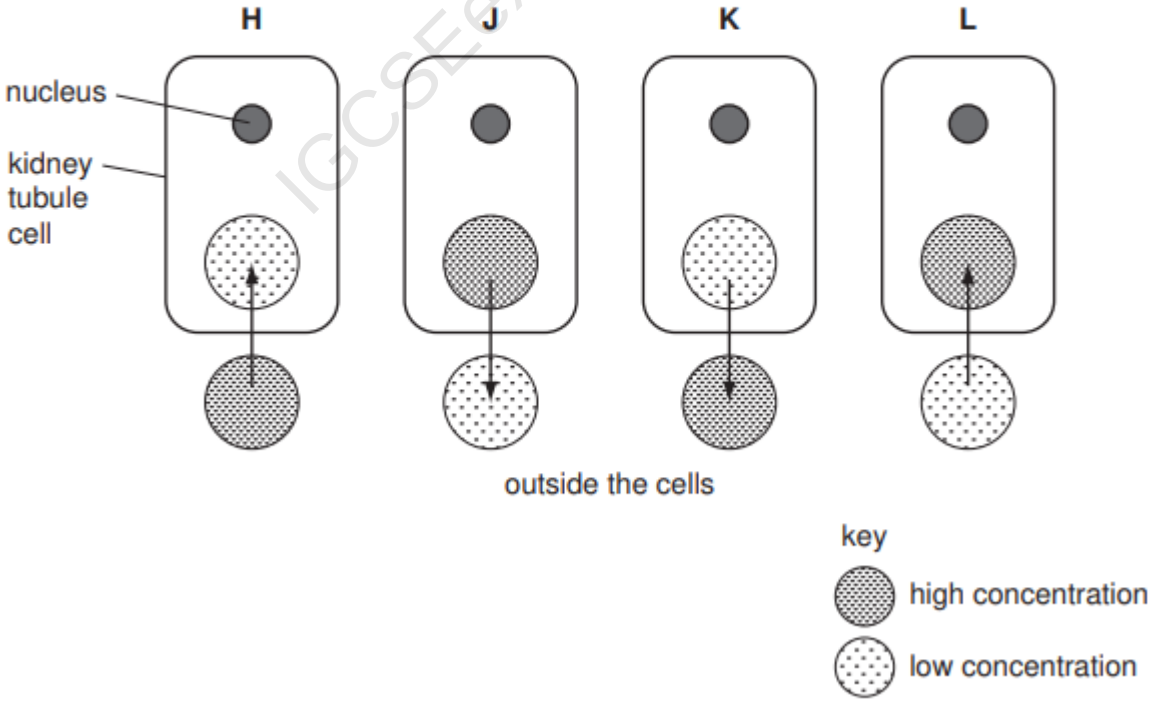


Fig. 3.2

(i) Complete Table 3.1 by stating the letter, **H**, **J**, **K** or **L**, which identifies each of the processes. Give a reason for each answer.

Table 3.1

process	letter	reason
diffusion of oxygen		
active uptake of sodium ions		

[4]

(ii) Glucose is filtered from the blood. Usually all of it is reabsorbed by the kidney tubules so that there is none present in the urine.

Name the part of the kidney where filtration occurs.

.....

[1]

(iii) Use Fig. 3.2 to describe how kidney tubules reabsorb glucose from the filtrate.

.....

.....

.....

.....

.....

[2]

(c) When plants are grown in a solution that includes a poison that prevents respiration, the roots continue to absorb water, but do **not** absorb many ions.

Explain this result.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 13]

4 Fig. 5.1 shows a cross-section of a kidney.

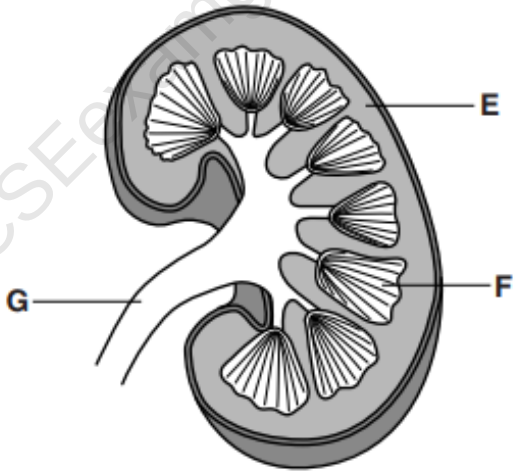


Fig. 5.1

(a) Name the structures labelled, **E**, **F** and **G** as shown in Fig. 5.1.

E .....

F .....

G ..... [3]

(b) Explain the function of the renal capsule in the kidney.

.....

.....

.....

.....

.....

.....

.....[3]

(c) Glucose is reabsorbed, back into the blood, by active transport.

Define *active transport*.

.....

.....

.....

.....

.....[2]

(d) Give **one** example, other than glucose, of a substance that is reabsorbed into the blood from the renal tubule.

.....[1]

(e) Dialysis is a treatment for kidney disease.

Fig. 5.2 shows a dialysis machine.

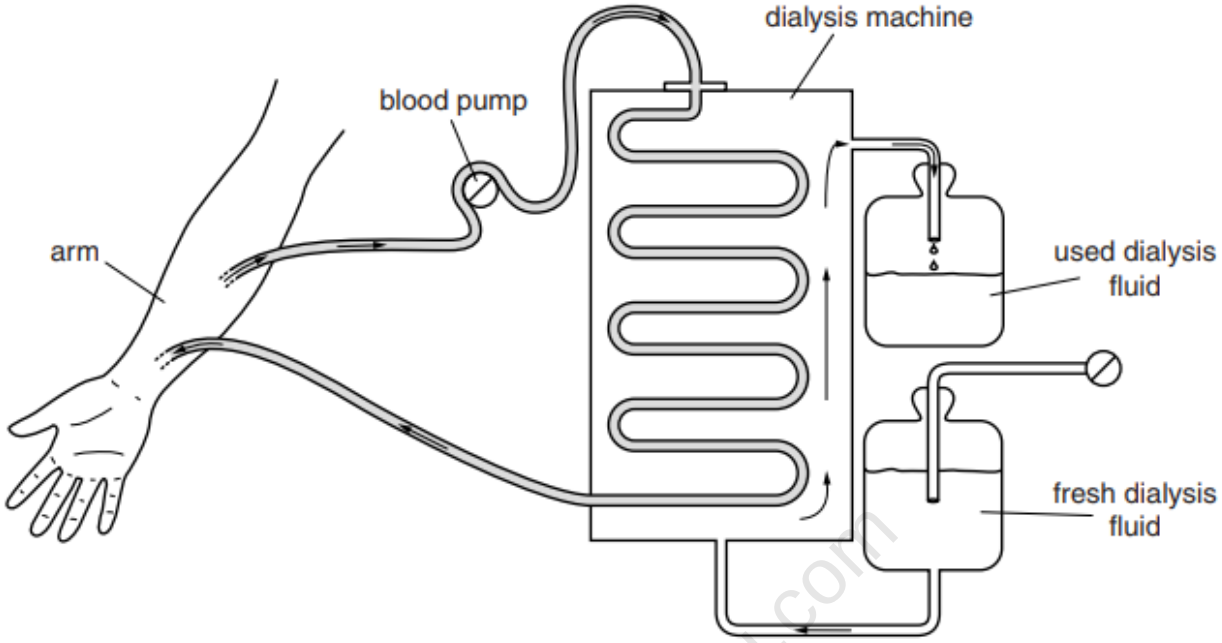


Fig. 5.2

(i) The composition of the dialysis fluid changes as it passes through the dialysis machine.

Complete Table 5.1 using the words 'low', 'high', 'same' or 'none' to show how the concentration of each substance changes in the dialysis fluid.

The last one has been done for you.

Table 5.1

	concentration of substance in:		
substance	blood before dialysis	**used** dialysis fluid	**fresh** dialysis fluid
glucose	normal		
salts	high		
urea	high		
toxins	high	high	low

[3]

(ii) Explain how a dialysis machine filters blood.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

(f) Kidney transplants are the most common organ transplants.

Describe the **advantages** of a kidney transplant compared with dialysis.

.....

.....

.....

.....

.....

.....

.....[3]

(g) Before a kidney is transplanted, it is important to match the tissue type of the donor with the tissue type of the recipient.

State why this is necessary.

.....

.....[1]

[Total: 20]

5 (a) Define the term *excretion*.

.....

.....

.....

.....

.....

.....[3]

Fig. 2.1 is a diagram of a kidney tubule and its blood supply.

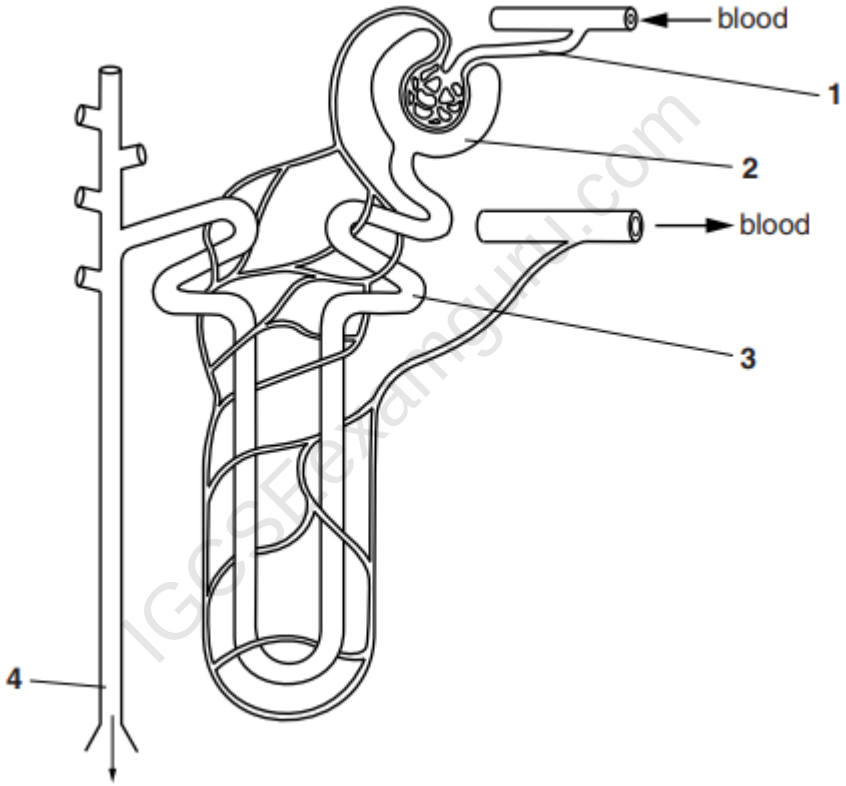


Fig. 2.1

(b) The concentrations of solutes in the fluids at regions **1**, **2**, **3** and **4** were determined. The results are shown in Table 2.1.

Table 2.1

substance	concentration / $g\,dm^{-3}$			
	region **1**	region **2**	region **3**	region **4**
glucose	0.9	0.9	0.2	0.0
protein	82.0	0.0	0.0	0.0
salts	8.0	8.0	9.6	16.5
urea	0.2	0.2	0.2	20.0

State the substance or substances in Table 2.1 which:

(i) has molecules which are too large to be filtered;

.....[1]

(ii) has molecules which are small enough to be filtered but is completely reabsorbed from the fluid in the kidney tubule;

.....[1]

(iii) increases in concentration as fluid moves along the kidney tubule.

1 .....

2 .....[1]

(c) State **three** structures through which the fluid from region **4** passes as it leaves the body.

1 .....

2 .....

3 .....[3]

(d) One role of the kidney is to maintain the concentration of the blood plasma.

Name the process of maintaining constant conditions within the body.

.....[1]

[Total: 10]

6 The lungs and the kidneys are excretory organs of the human body.

(a) (i) Define the term *excretion*.

.....

.....

.....

.....

.....

.....

.....[3]

(ii) State an excretory product that is passed out through the lungs.

.....[1]

(iii) Outline the role of the liver in excretion.

.....

.....

.....

.....

.....

.....

.....[3]

(b) Fig. 4.1 is a vertical section of the kidney.

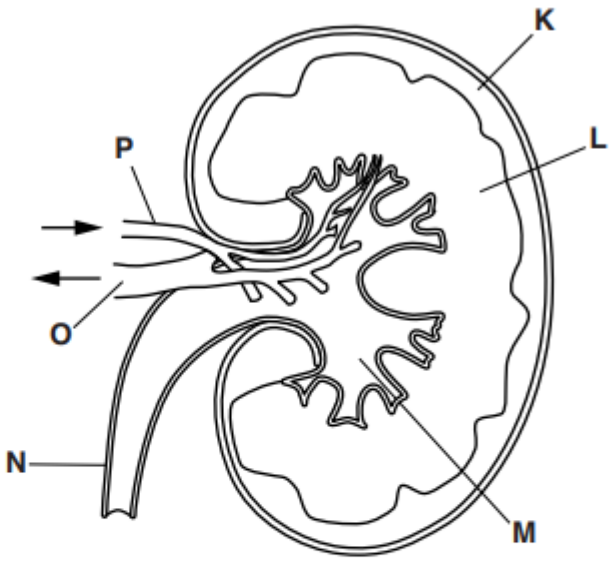


Fig. 4.1

Table 4.1 shows the functions of parts of the kidney.

Complete the table by:

- naming the part of the kidney that carries out each function
- using letters from Fig. 4.1 to identify the part of the kidney named.

One row has been completed for you.

Table 4.1

function	name of part	letter from Fig. 4.1
blood is filtered		
concentration of urine is determined	medulla	**L**
urine flows to the bladder		
blood is carried into the kidney		
blood flows out of the kidney		

[4]

(c) People with kidney disease are often treated in renal dialysis clinics. Their blood passes through tubes lined with a special membrane for about three hours.

(i) State **two** waste substances that are removed from the blood by dialysis.

1 .....

2 .....

[2]

(ii) Kidney patients may be given a kidney transplant. State **one** advantage and **one** disadvantage of kidney transplants compared with dialysis.

advantage .....

.....

.....

disadvantage .....

.....

.....

[2]

[Total: 15]

1 **(a)** Define the term *growth*.

.....

.....

.....

..... [2]

Some students investigated the responses of tomato seedlings to receiving light from one side (unidirectional light).

The students germinated tomato seeds in the dark and then placed the seedlings in test-tubes with water. The seedlings were treated in four different ways, **E** to **H**, as shown in Fig. 2.1. The responses of the seedlings are shown in Fig. 2.2.

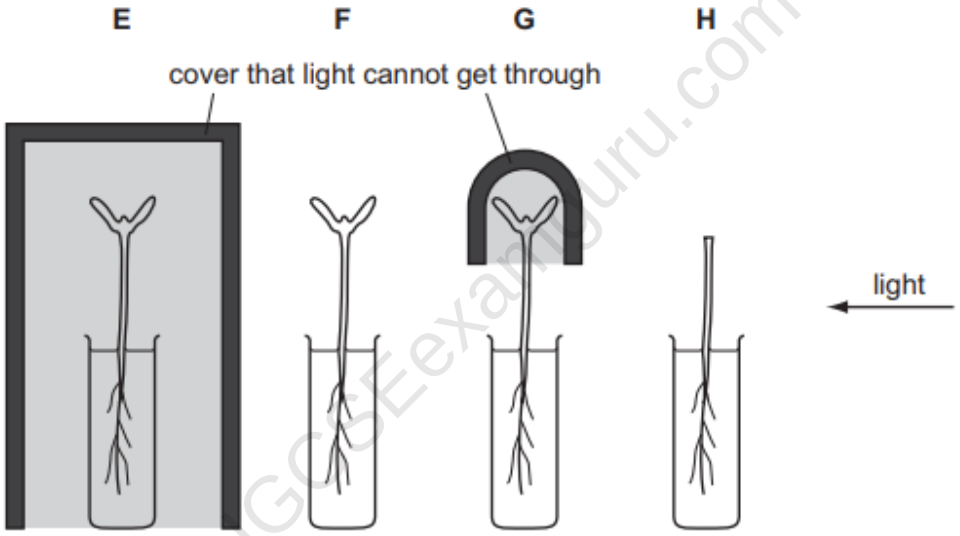


Fig. 2.1

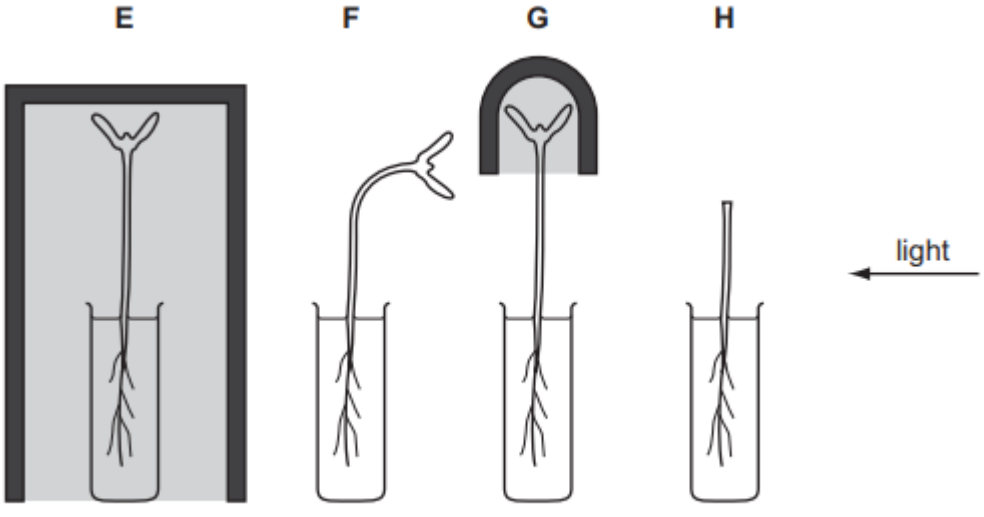


Fig. 2.2

(b) Name the response shown by the tomato seedling, **F**, which has bent 90° towards the light.

.....

[2]

(c) Using the results shown in Fig. 2.2, suggest what conclusions may be made about how the tomato seedlings detected the stimulus of unidirectional light.
You may refer to the seedlings by the letters **E** to **H**.

.....

.....

.....

.....

.....

.....

.....

.....

[3]

(d) Explain the advantage of the response shown by seedlings to unidirectional light.

.....

.....

.....

.....

.....

[2]

(e) Responses to light are coordinated by plant growth substances known as auxins.

Explain the role of auxins in coordinating the response.

.....

.....

.....

.....

.....

[2]

(f) Research workers in India tested the hypothesis that pigments in tomato seedlings detect blue light. They used a variety of tomato seedling that does **not** have the ability to make a certain pigment.

These seedlings and a control group of seedlings were grown in the dark and then exposed to unidirectional blue light for 360 minutes.

The scientists measured the degree of bending of the seedlings at intervals during the 360 minutes. Their results are shown in Fig. 2.3.

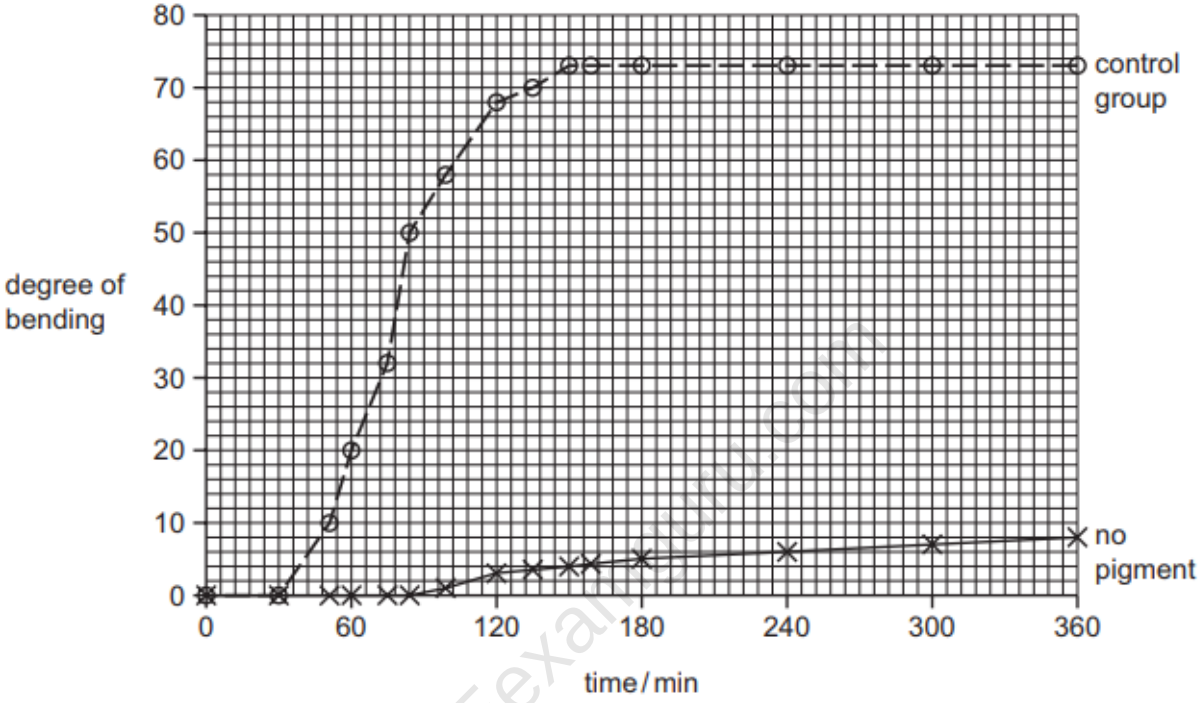


Fig. 2.3

(i) Describe the results shown in Fig. 2.3.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(ii) Suggest an explanation for the differences between the responses of the two groups of seedlings.

.....

.....

.....

.....

.....

..... [2]

[Total: 17]

2 The light sensitive cells in the eye are known as rods and cones.

Fig. 2.1 shows drawings of a rod cell and a cone cell.

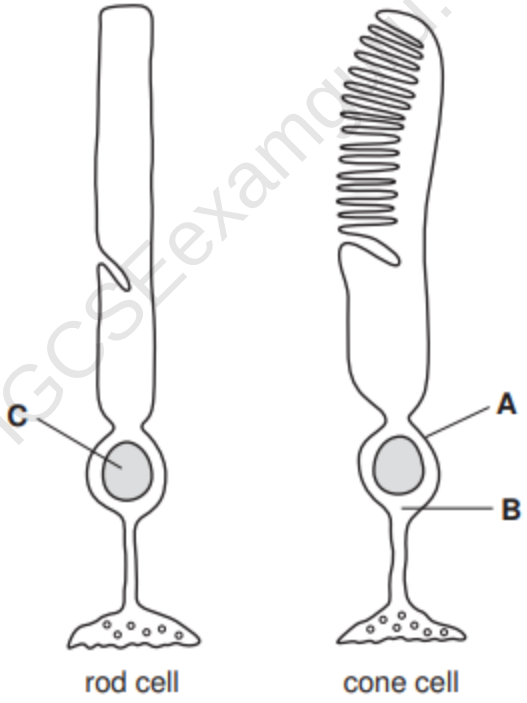


Fig. 2.1

(a) Name the structures labelled **A** to **C**.

A .....

B .....

C ..... [3]

(b) (i) Name the tissue in the eye where rods and cones are found.

..... [1]

(ii) Name the parts of this tissue where there are

cones but no rods .....

no cones or rods ..... [2]

(c) Describe how rods and cones function.

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 10]

3 The glucose concentration of the blood is maintained within the range 80 – 90 mg per 100 cm^3 blood.

Fig. 2.1 is a flow chart showing how the body responds to changes in the glucose concentration of the blood after the absorption of a carbohydrate-rich meal and during strenuous exercise.

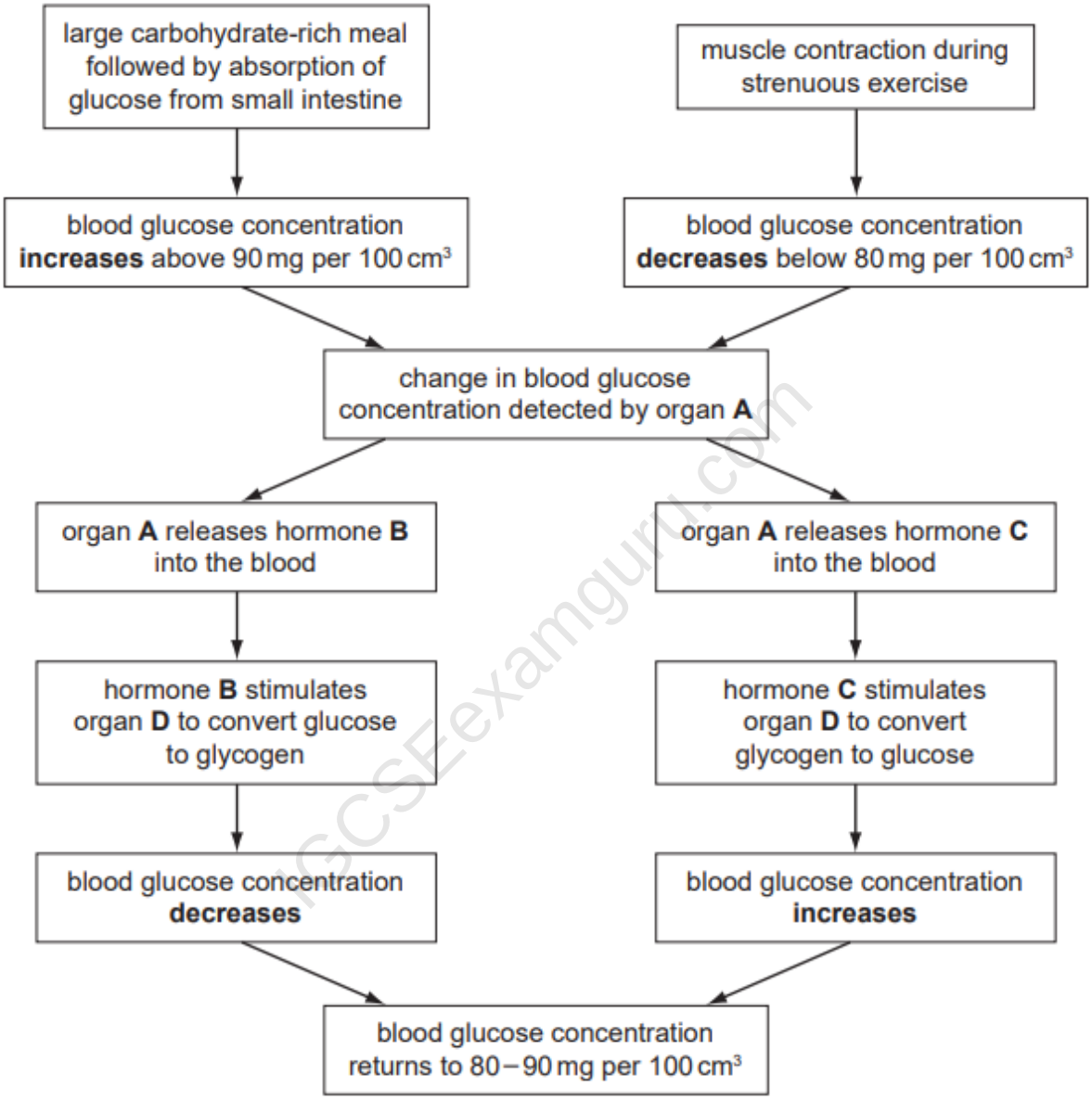


Fig. 2.1

(a) Name organ **A** and hormones **B** and **C**.

A .....

B .....

C ..... [3]

(b) **(i)** Name organ **D** that stores glucose as glycogen.

..... [1]

(ii) Suggest why glucose is converted to glycogen rather than kept as glucose inside the cells.

.....

.....

.....

..... [2]

(c) Name the type of control system used in homeostasis that returns the blood glucose concentration to 80–90 mg per 100 cm^3.

..... [1]

(d) Animal hormones are used in the production of milk and meat. Bovine somatotrophin (BST) is used to increase milk production by cows. The hormone is produced by genetically modified bacteria that contain the cattle gene for making BST. It is used in the United States but is banned for use in the European Union.

(i) Outline how genes, such as the one for BST, are transferred from the cells of cattle (cows) to bacteria.

.....

.....

.....

.....

.....

..... [3]

(ii) Suggest advantages **and** disadvantages of using hormones, such as BST, in the production of milk and meat.

advantages .....

.....

.....

.....

disadvantages .....

.....

.....

..... [3]

[Total: 13]

4 Fig. 3.1 shows the front part of the eye.

The eye shown in Fig. 3.1 is **far adapted**, which means that the lens is focusing light from a distance.

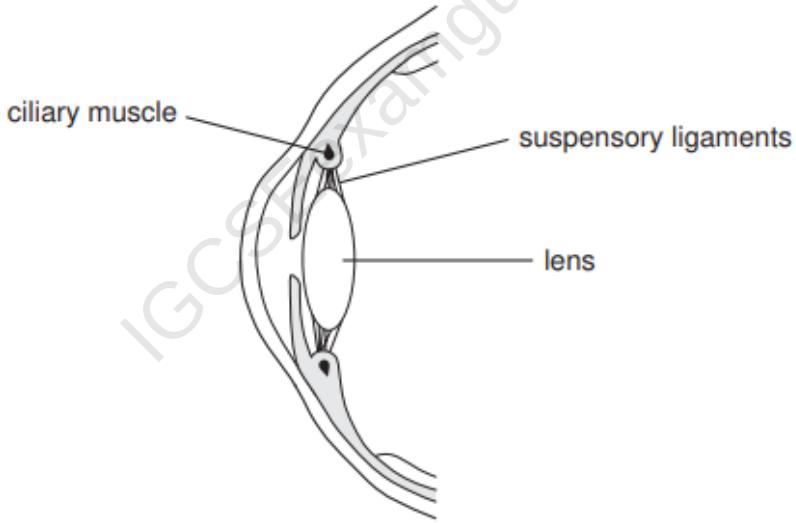


Fig. 3.1

The lens changes shape to alter the direction of light rays passing through the eye.

(a) Name:

(i) another part of the eye that also alters the direction of the light rays;

..... [1]

(ii) the part of the eye where the light rays form an image.

..... [1]

(b) An eye specialist measured the change in shape of the lens of a patient during an eye test. The specialist recorded the change in shape of the lens with the patient looking at a chart 10 metres away and when reading from a book. This is shown in Fig. 3.2.

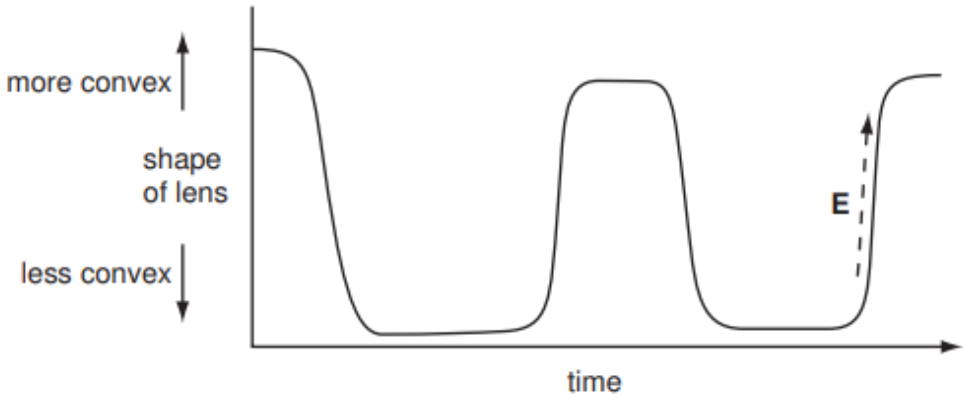


Fig. 3.2

(i) Write the letter **D** on Fig. 3.2 to show a time when the patient was looking at the chart that was 10 metres away. [1]

(ii) State how the ciliary muscles and suspensory ligaments act to change the shape of the lens during the time marked **E** on Fig. 3.2.

ciliary muscles .....

.....

suspensory ligaments .....

..... [2]

(c) Outline how humans are able to see in colour.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 8]

5 Fig. 3.1 shows a diagram of a cell from the pancreas that secretes the hormone, insulin.

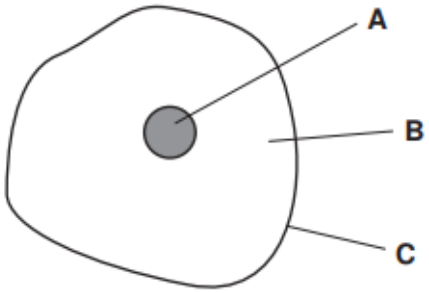


Fig. 3.1

(a) State **one** function of each of the parts of the cell labelled **A**, **B** and **C**.

A .....

B .....

C ..... [3]

(b) Glucose in the blood is absorbed by liver cells and muscle cells. These cells convert glucose to glycogen for storage.

Explain why glucose needs to be converted to glycogen for storage rather than remaining dissolved in the blood.

.....

.....

.....

.....

..... [2]

(c) Other cells in the pancreas secrete the hormone glucagon.

Glucagon stimulates liver cells, but has no effect on muscle cells.

(i) State the effect that glucagon has on liver cells.

.....

..... [1]

(ii) State how hormones, such as glucagon and insulin, travel around the body.

.....

..... [1]

(d) Hormone Growth Promotants (HGPs) are hormones. HGPs are used to improve the production of food from animals.

Many of these HGPs are hormones that are secreted naturally by the gonads (ovaries and testes).

Name **two** hormones that are secreted by the gonads.

1 .....

2 ..... [2]

(e) The hormones are given to cattle by placing implants behind the ears. These release the hormones slowly during the animal's life time.

The advantages of using HGPs in meat production are:

- more meat is produced per animal;
- a 15 to 30 % increase in growth rate;
- a 5 to 15 % improvement in conversion of feed into meat;
- a decrease in greenhouse emissions from cattle.

Suggest:

(i) the advantages of an increase in the conversion of feed into meat for the farmer;

.....

.....

.....

.....

..... [2]

(ii) how the use of HGPs leads to a decrease in greenhouse emissions from cattle.

.....

.....

.....

.....

..... [2]

(f) HGPs are used in animal production systems in North America and Australia.

The European Union (EU) has banned the use of HGPs and the import of meat from countries where the hormones are used.

Suggest reasons for the ban on the use of HGPs in the EU.

.....

.....

.....

.....

..... [2]

[Total: 15]

6 **(a)** Complete Table 5.1 by naming **three** sense organs and the stimulus which each detects.

Table 5.1

sense organ	stimulus

[3]

(b) Reflexes are involuntary actions coordinated by reflex arcs like the one shown in Fig. 5.1.

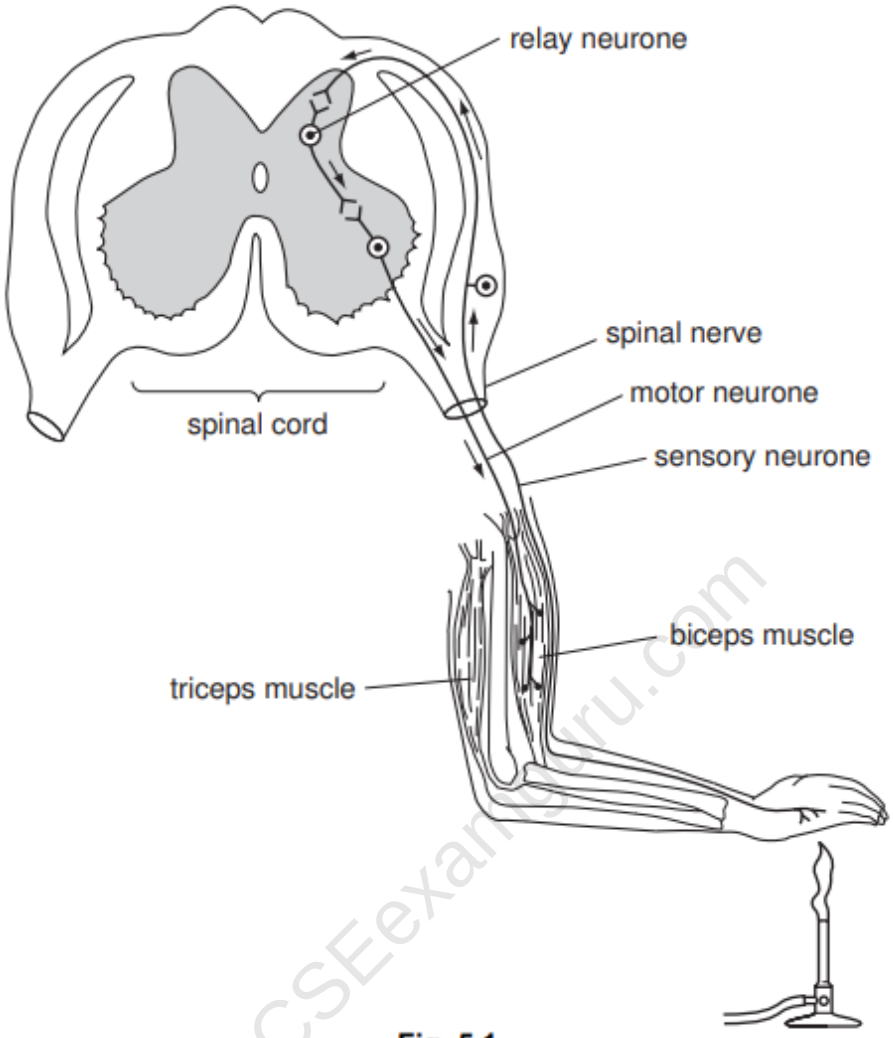


Fig. 5.1

(i) Explain what is meant by the term *involuntary action*.

.....

.....

.....

.....

..... [2]

(ii) The arm shown in Fig. 5.1 moves in response to the detection of heat.

Explain how the parts of the reflex arc shown in Fig. 5.1 bring about this response.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(iii) Describe the advantages of simple reflexes, such as the one shown in Fig. 5.1.

.....

.....

.....

.....

..... [2]

(c) The organs of the human body are coordinated by the nervous system.

Outline **one** other way in which these organs are coordinated.

.....

.....

.....

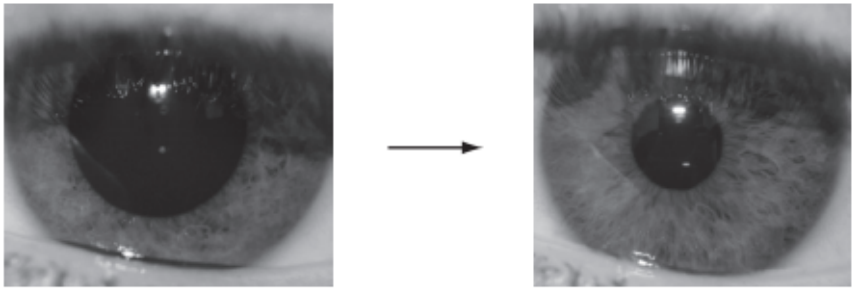
.....

..... [2]

[Total: 14]

7 **(a)** Fig. 2.1 shows a reflex action that involves the eye.

A shows an eye in dim light. **B** shows the same eye when a bright blue light is shone into it.



A bright blue light **B**

Fig. 2.1

(i) Identify the:

- stimulus to which the eye responds;
- receptor cells that detect the stimulus;
- effector;
- response that the eye makes.

Write your answers in Table 2.1.

Table 2.1

stimulus	
receptor cells	
effector	
response	

[4]

(ii) Describe how the nervous system coordinates the response shown in Fig. 2.1.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) Adrenaline is secreted by the adrenal glands to prepare the body for dangerous situations.

Extreme sports, such as bungee jumping shown in Fig. 2.2, are an example of such a dangerous situation.

Fig. 2.2

Explain how adrenaline prepares the body for an extreme sport, such as making a bungee jump.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(c) The response shown in Fig. 2.1 is involuntary.

Bungee jumping is a voluntary action.

Describe **two** ways in which involuntary actions differ from voluntary actions.

.....

.....

.....

.....

..... [2]

[Total: 15]

8 Fig. 3.1 is a diagram that shows the control of blood glucose concentration.

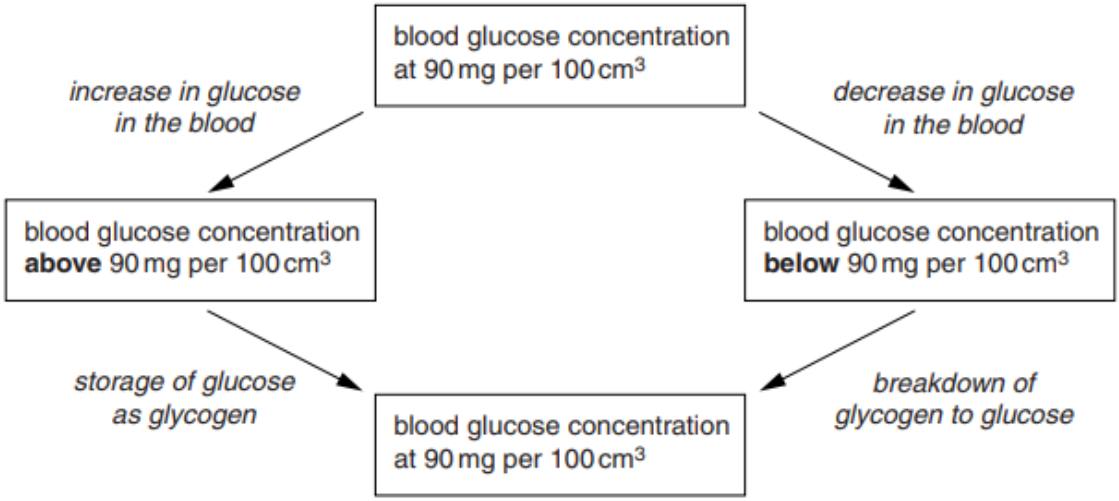


Fig. 3.1

(a) (i) State **one** reason why the concentration of glucose in the blood **increases**.

.....

.....[1]

(ii) State **one** reason why the concentration of glucose in the blood **decreases**.

.....

.....[1]

(iii) Name **two** places in the body where glycogen is stored.

1 .....

2 .....

[2]

(b) Explain how an increase in glucose concentration is controlled in the body.

.....

.....

.....

.....

.....

.....[3]

(c) If the blood glucose concentration is very high there is a decrease in the water potential of the blood. This may damage the red blood cells.

Explain how a decrease in water potential of the blood may damage red blood cells.

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 10]

9 **(a)** Define the term *sensitivity.*

.....

.....

.....

.....[2]

(b) Describe how voluntary actions differ from involuntary actions.

.....

.....

.....

.....

.....[2]

(c) Name the neurone that transmits impulses from a receptor.

.....[1]

(d) Reaction time is defined as the time taken to respond to a stimulus.

During a swimming relay race, the reaction times of four swimmers in two teams, **A** and **B**, were recorded.

In each team, swimmer 1 responded to the sound of the start gun; swimmers 2, 3 and 4 responded to seeing the previous swimmer touch the swimming pool wall.

Table 3.1 shows the reaction times for the swimming relay teams.

Table 3.1

swimmer	reaction time/s	
	team **A**	team **B**
1	0.81	0.75
2	0.48	0.40
3	0.58	0.06
4	0.31	0.35

Compare the reaction time of swimmer 1 in each team with the reaction times of the other swimmers in each team. Use the information in Table 3.1 to support your answer.

.....

.....

.....

.....

.....

.....

.....[3]

(e) Adrenaline is often secreted during sporting competitions.

Outline how adrenaline affects the performance of a swimmer.

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 11]

10 Fig. 3.1 is a diagram of human skin in cold weather.

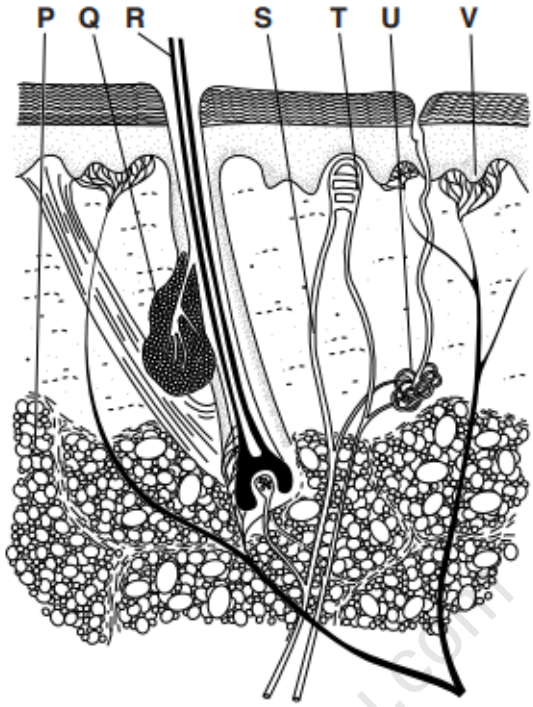


Fig. 3.1

(a) Table 3.1 shows the responses of the skin to cold weather.

Complete the table by:

- naming the parts of the skin that respond to cold weather
- using the letters (**P** to **V**) from Fig. 3.1 to identify these parts of the skin.

Table 3.1

responses of skin to cold weather	name of part	letter from Fig. 3.1
stands upright to trap air		
constricts to reduce blood flow to skin		
stops producing sweat		

[3]

(b) The response of the skin to cold weather is an involuntary action.

Explain how an involuntary action differs from a voluntary action.

.....

.....

.....

.....

.....

.....

.....[3]

(c) Describe how the nervous system coordinates the response of the skin to cold weather.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

(d) Explain how negative feedback is involved in the control of body temperature.

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 13]

2 Fig. 2.1 shows a diagram of the liver and the blood vessels that enter and exit from it.

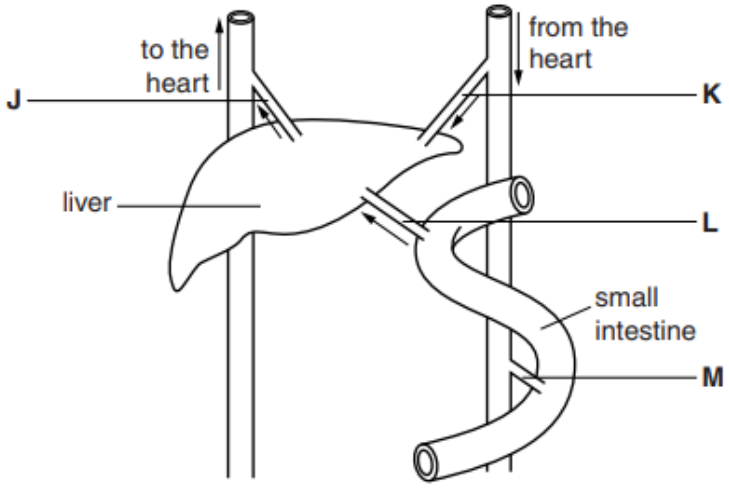


Fig. 2.1

(a) Name blood vessel **L**.

.....[1]

(b) Blood vessel **J** is a vein.

State **two** structural features of veins and explain how each feature is related to its function of returning blood to the heart.

feature .....

explanation .....

.....

feature .....

explanation .....

.....[4]

(c) Blood samples were taken from each of the blood vessels **J**, **K**, **L** and **M** two hours after a meal of rice. Table 2.1 shows the concentration of glucose in these blood samples.

Table 2.1

blood vessel	blood glucose concentration /mg per 100 cm^3
J	135
K	128
L	181
M	133

Calculate the percentage increase in blood glucose concentration between blood vessel **J** compared with **L**. Express your answer to the nearest whole number.

Show your working.

..... %
[2]

(d) Control of blood glucose by the liver is an example of homeostasis.

(i) Explain how the liver lowers blood glucose concentration when it is too high.

.....

.....

.....

.....

.....[2]

(ii) Name **one other** factor in the human body that is also controlled by homeostasis.

.....

.....[1]

(e) Amino acids are processed by the liver.

Describe this process.

.....

.....

.....

.....

.....

.....

.....[3]

(f) State **one other** function of the liver, besides homeostasis and processing amino acids.

.....

.....[1]

[Total: 14]

Chapter 15: Drugs

1 The liver is an organ with a large number of different functions.

Fig. 4.1 shows the liver, its blood supply and some other organs. The blood vessels are labelled **P** to **R**.

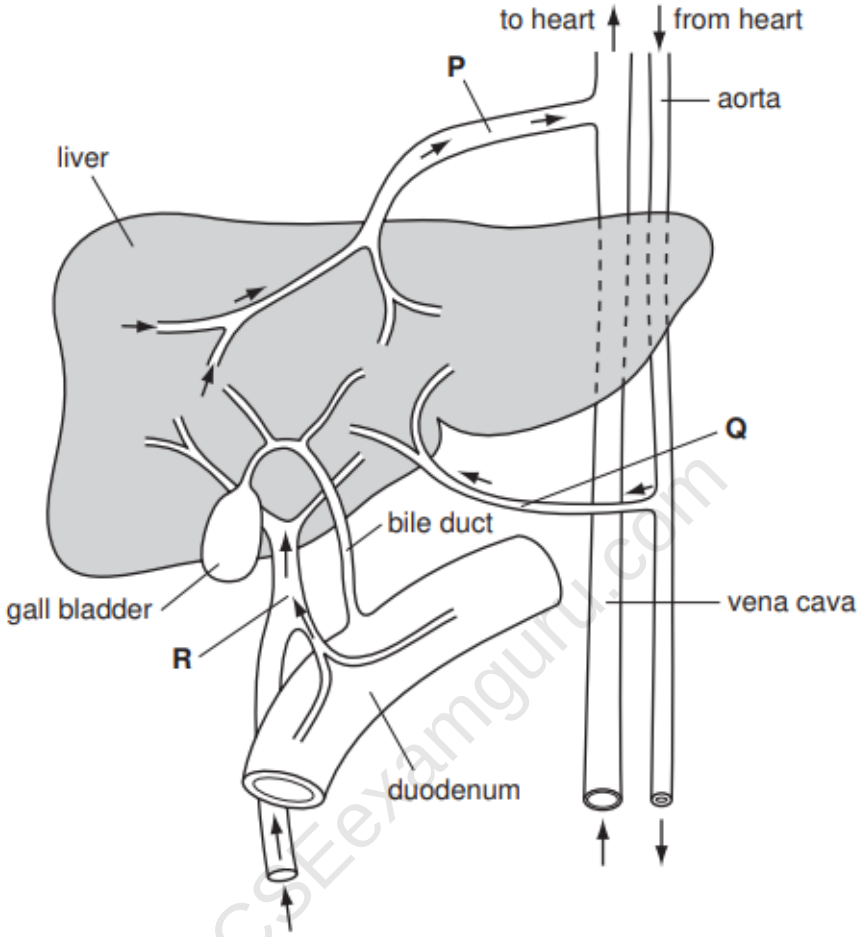


Fig. 4.1

(a) A person eats a meal containing protein and carbohydrate.

Complete Table 4.1 to show the blood vessel that has the **highest** concentration of glucose, oxygen and urea as this meal is absorbed.

Use the letter, **P**, **Q** or **R** to identify each blood vessel.

Table 4.1

substance transported by blood	letter of blood vessel in Fig. 4.1
glucose	.....
oxygen	.....
urea	.....

Write the letters for the blood vessels with the **highest** concentration of each substance in the spaces on Table 4.1. [3]

(b) Amino acids are absorbed from the small intestine and transported to the liver.

Describe how the liver is involved in the metabolism of amino acids.

.....

.....

.....

.....

.....

..... [3]

(c) Describe the effects on the liver of the following.

(i) insulin released from the pancreas

.....

.....

.....

.....

..... [2]

(ii) adrenaline released from the adrenal glands

.....

.....

.....

.....

..... [2]

(iii) excessive long-term consumption of alcohol

.....

.....

.....

.....

..... [2]

(d) Cholesterol can accumulate in the gall bladder to form gall stones. These gall stones may stop bile flowing from the liver through the bile duct and into the duodenum.

Explain the possible effect of gall stones on the digestion of fat.

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 16]