



Chapter 12 Homeostasis in Action

Name: _____

Class: _____

Date: _____

Time: **218 minutes**

Marks: **218 marks**

Comments:

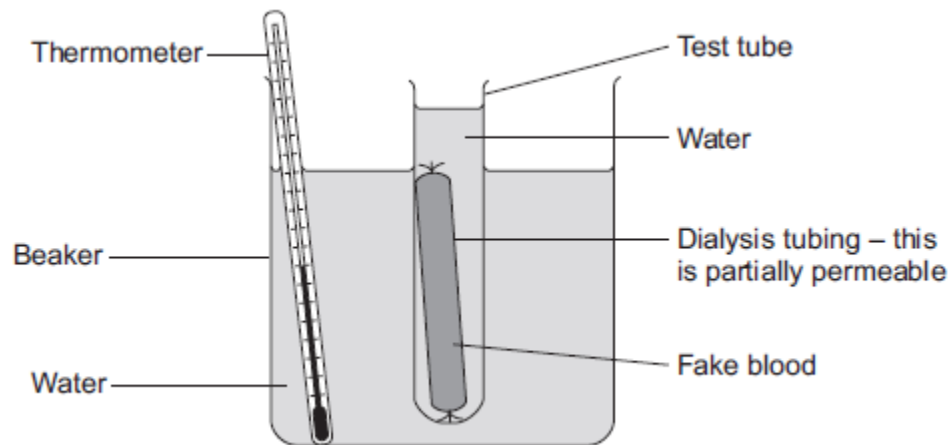
1

A person's kidneys stop working. The person may be treated using a dialysis machine.

Some students made a model of a dialysis machine.

Figure 1 shows the students' model.

Figure 1



The fake blood contained:

- water
- sodium ions
- urea
- glucose
- protein.

(a) (i) Suggest why the students kept the water in the beaker at 37 °C.

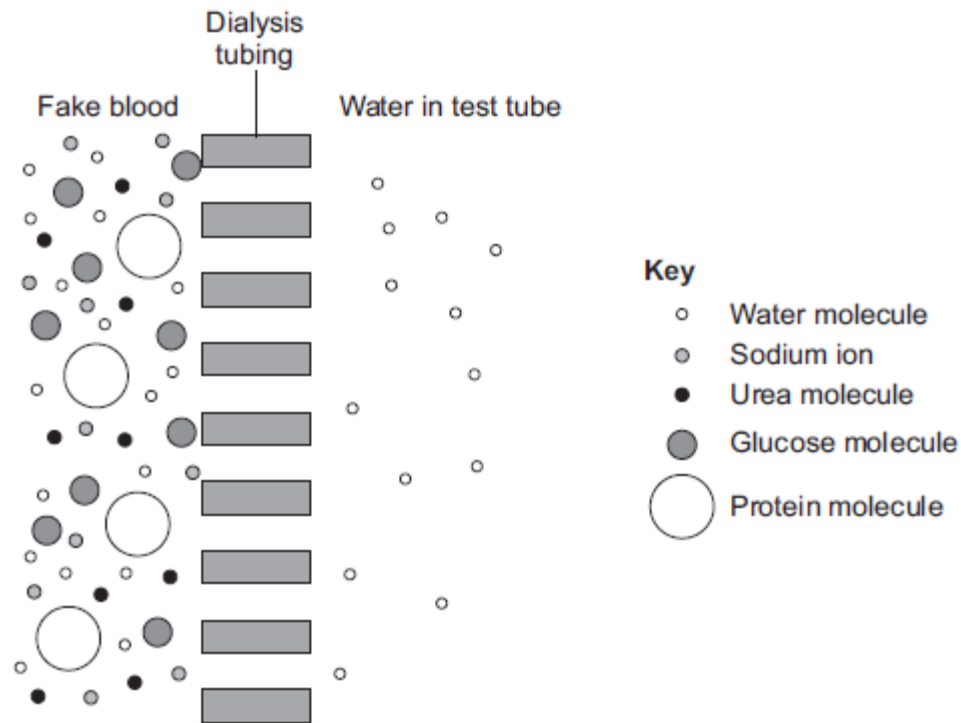
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(1)

- (ii) The dialysis tubing separates the fake blood from the water in the test tube.

Figure 2 shows the fake blood, the dialysis tubing and the water in the test tube.

Figure 2



After 1 hour, the students tested the water in the test tube to see which substances had filtered through from the fake blood.

Name **one** substance that the students would find in the water in the test tube after 1 hour.

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(1)

- (iii) Give a reason for your answer to part **(a)(ii)**.

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(1)

- (iv) In hospitals, dialysis machines use dialysis fluid, not pure water.

Dialysis fluid contains the same concentration of useful substances as the blood.

Which substance is at the same concentration in dialysis fluid as in blood?

Tick (✓) **one** box.

Glucose

☐

Insulin

☐

Oxygen

☐

(1)

- (b) When the kidneys stop working, the person can be treated by a continuous process called CPD.

In CPD:

- dialysis fluid is put into the abdomen
- the fluid is changed four times a day at home
- changing the fluid takes about 45 minutes.

Suggest **two** advantages of having CPD instead of treatment on a dialysis machine.

1

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2

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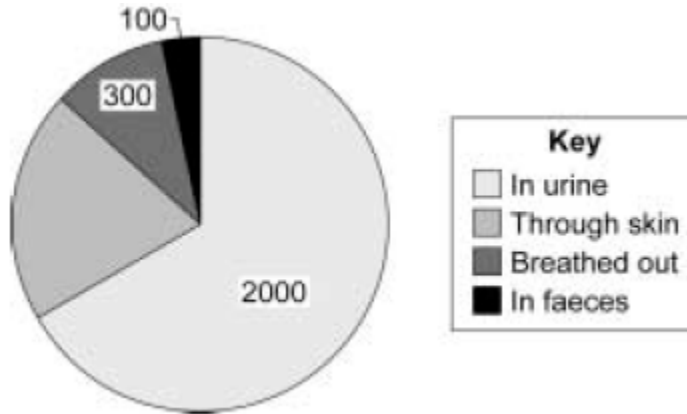
(2)

(Total 6 marks)

2

Water is lost from the body in several ways.

The pie chart shows the volume of water lost, in cm^3 , by a man on a cold day.



- (a) (i) The total volume of water lost by the man was 3000 cm^3 .

How much water was lost through the skin?

Volume of water lost through skin cm^3

(1)

- (ii) The same man lost 1200 cm^3 of water through the skin on a warm day.

Give **one** reason for the different volumes of water lost on the two days.

.....

(1)

- (b) To maintain water balance in the body, the total volume of water taken in must equal the total volume of water lost.

Give **two** ways this is achieved on a hot day, when compared to a cold day.

Tick (✓) **two** boxes.

The volume of water in the urine decreases.

☐

The volume of water in the faeces increases.

☐

The volume of water taken as food or drink increases.

☐

The volume of water breathed out decreases.

☐

(2)

(Total 4 marks)

3

The kidneys produce urine.

The table shows the composition of a sample of urine from one person.

Substance	Percentage
Ions	2.5
Urea	2.6
Water	

- (a) (i) Calculate the percentage of water in this sample of urine.

Show clearly how you work out your answer.

.....

.....

Percentage of water = %

(2)

- (ii) The urine of a healthy person does **not** contain protein.

What is the reason for this?

Tick (✓) **one** box.

Protein molecules in the plasma cannot pass through the filter in the kidney.

☐

Protein molecules in the plasma can pass through the filter in the kidney and are then reabsorbed.

☐

There are no protein molecules in the plasma.

☐

(1)

- (b) Dialysis can be used to treat a person with kidney disease.

Draw a ring around the correct answer to complete each sentence.

- (i) The dialysis machine contains membranes that are

fully permeable.
impermeable.
partially permeable.

(1)

- (ii) At the end of a dialysis session, the concentration of substances in the blood would be

higher than
lower than
the same as

the concentration of substances in the dialysis fluid.

(1)

- (c) For most patients, a kidney transplant is better than continued treatment by dialysis.

Kidney transplants have some disadvantages.

Give **one** disadvantage of a kidney transplant.

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(1)

(Total 6 marks)

4

The volume of water the body needs depends on a number of factors.

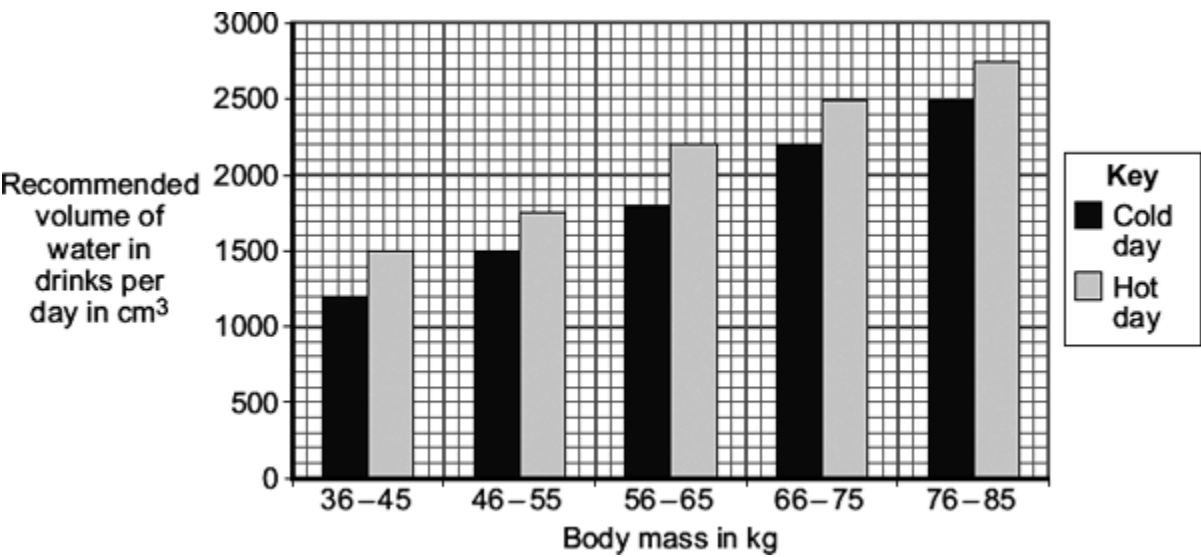
- (a) Water enters the body in drinks.

Give **one** other way the body can get water.

.....

(1)

(b) The chart shows the recommended volume of water that women of different body masses should drink, on a cold day and on a hot day.



(i) Describe the relationship between body mass and the recommended volume of water that a woman should drink.

.....

(1)

(ii) What is the recommended volume of water that a 70 kg woman should drink on a cold day?

..... cm³

(1)

(iii) While following a diet, the 70 kg woman loses 10 kg of body mass.

Calculate how much less water she is recommended to drink on a cold day.

Use information from the chart.

Show clearly how you work out your answer.

.....

Answer = cm³

(2)

(c) It is recommended that women should drink more water on a hot day than on a cold day.

Why?

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.....

(2)

(d) Excess water is lost from the body in urine.

Name the organ that produces urine.

.....

(1)

(Total 8 marks)

5

A runner might drink a special ‘sports drink’ at intervals during a marathon race. The table shows the substances present in a sports drink.

Substance	Percentage
Water	
Sugar	5.0
Ions	0.2

(a) Complete the table to show the percentage of water in the sports drink.

(1)

(b) The runner sweats and also breathes heavily during the race.

(i) Why does the runner need to sweat?

.....

(1)

(ii) Which **two** substances in the table are lost from the body in sweat?

.....

(1)

(iii) Which substance in the table is lost from the body during breathing?

.....

(1)

(c) How does the sugar in the sports drink help the athlete during the marathon?

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.....

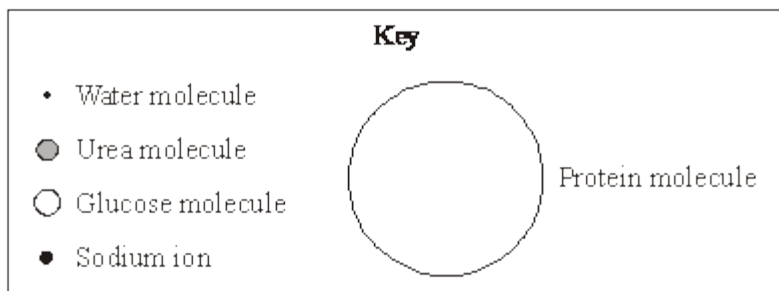
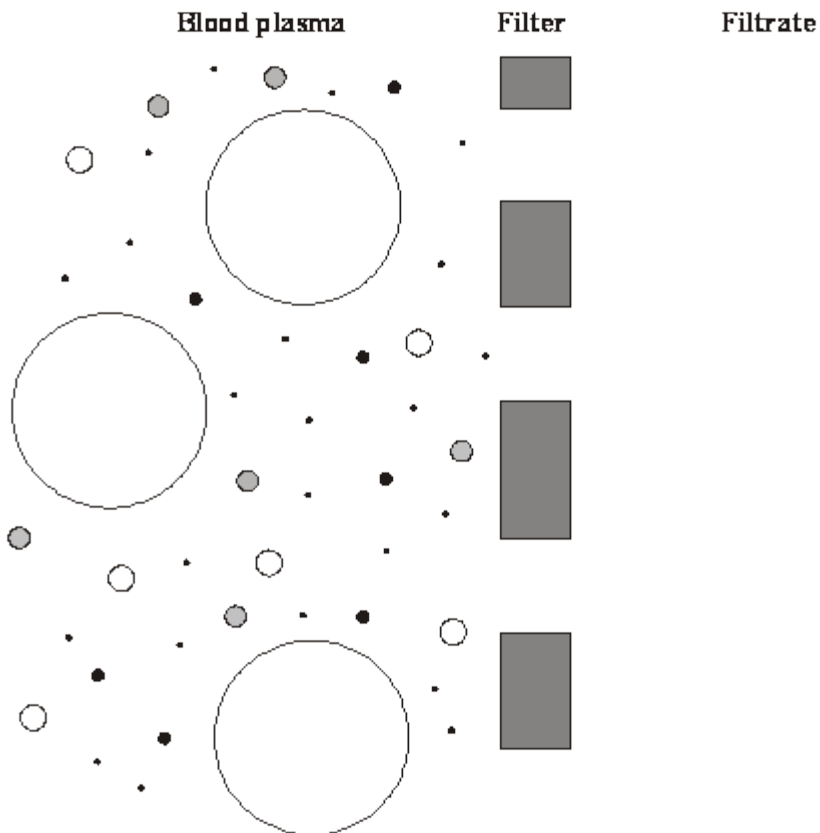
(2)

(Total 6 marks)

6

The kidneys filter the blood.

The diagram shows the site of filtration in the kidney.



- (a) Use information from the diagram to answer this question.

Put a tick (✓) in the box next to every substance that will pass through the filter from the blood plasma into the filtrate.

One has been done for you.

glucose	<input checked="" type="checkbox"/>
urea	<input type="checkbox"/>
water	<input type="checkbox"/>
sodium ions	<input type="checkbox"/>
protein	<input type="checkbox"/>

(2)

- (b) Proteins and glucose are not present in the urine of a healthy person.

- (i) Use information from the diagram to explain why protein is not found in the urine of a healthy person.

.....
.....

(1)

- (ii) Complete the sentence by drawing a ring around the correct answer.

After filtration, all the glucose is

reabsorbed
released
respired

(1)

- (c) An athlete trained on a hot day and on a cold day. On each day, he did the same amount of exercise and drank the same volume of water.

Complete the sentences by drawing a ring around the correct answer.

- (i) On the hot day, the athlete would produce

less
more
the same amount of

urine.

(1)

- (ii) This is because he would produce

less
more
the same amount of

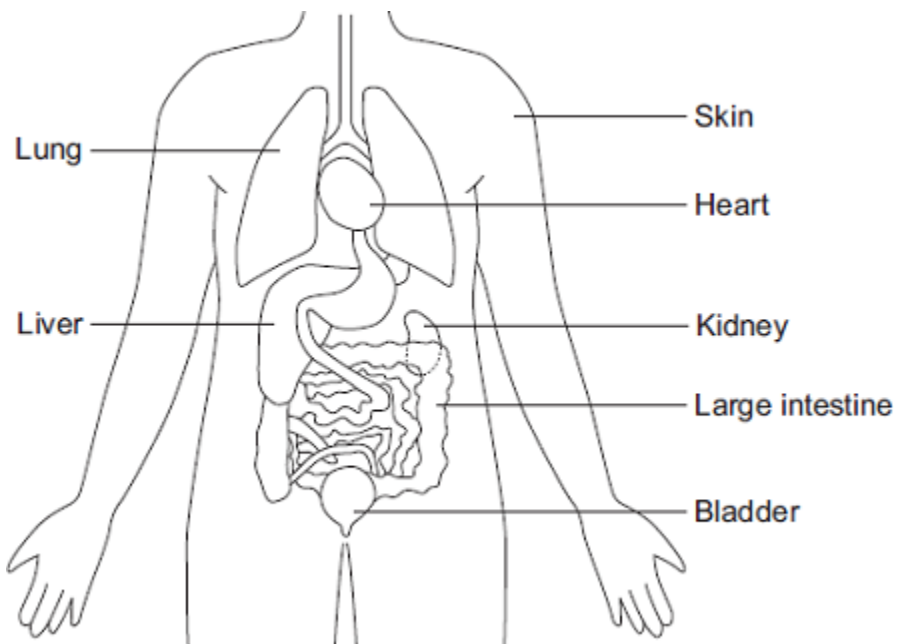
sweat.

(1)

(Total 6 marks)

7

The diagram shows some of the organs of the human body.



- (a) Which organ labelled on the diagram:

- (i) produces urine

(1)

- (ii) stores urine

(1)

(iii) produces urea

(1)

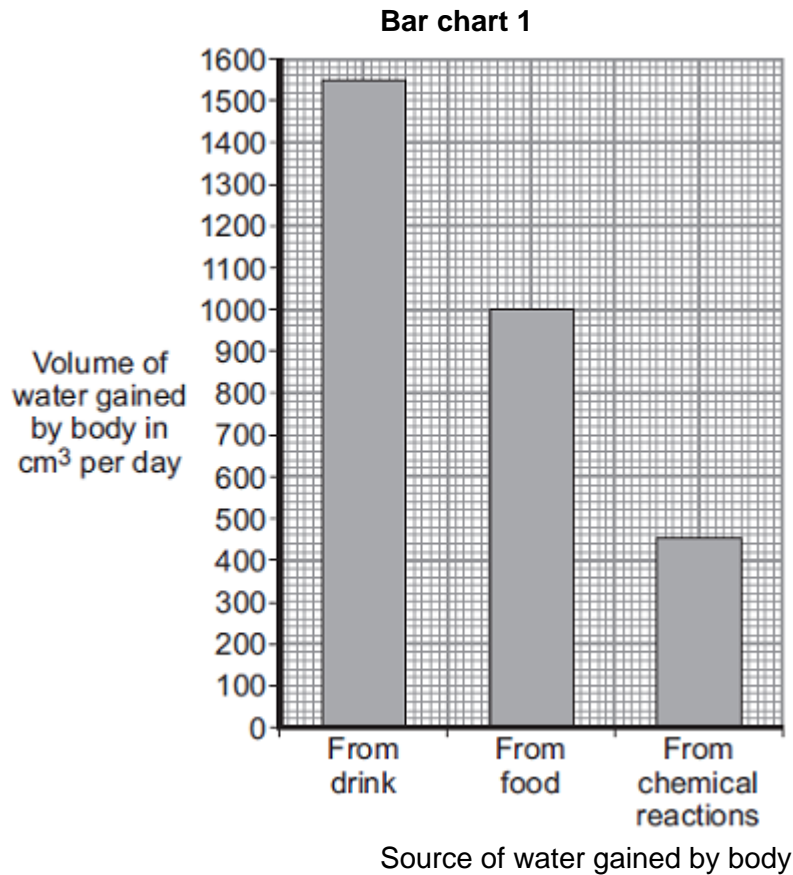
(iv) gets rid of carbon dioxide

(1)

(v) helps to control body temperature?

(1)

(b) **Bar chart 1** shows the volume of water the human body gains each day.



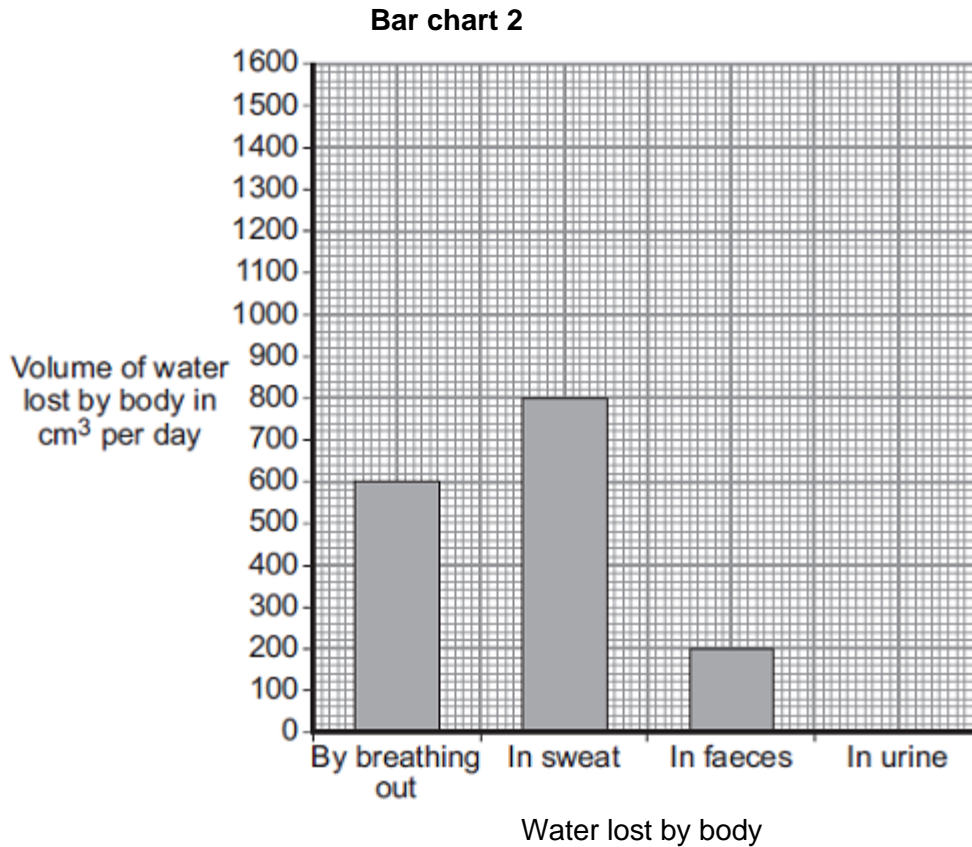
(i) Calculate the total volume of water the body gains each day.

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.....
.....

Total volume of water gained = cm³

(2)

Bar chart 2 shows the volume of water lost each day by breathing out, in sweat and in faeces.



- (ii) Calculate the total volume of water lost each day by breathing out, in sweat and in faeces.

.....

Volume = cm^3

(1)

- (iii) The volume of water the body loses must balance the volume of water the body gains.

Use your answers to part (b)(i) and part (b)(ii) to calculate the volume of water lost in urine.

.....

Volume of water lost in urine = cm^3

(1)

(iv) Plot your answer to part (b)(iii) on **Bar chart 2**.

(1)

(v) After taking some types of recreational drugs, the kidneys produce very little urine.

What happens to the body cells if the kidneys produce very little urine?

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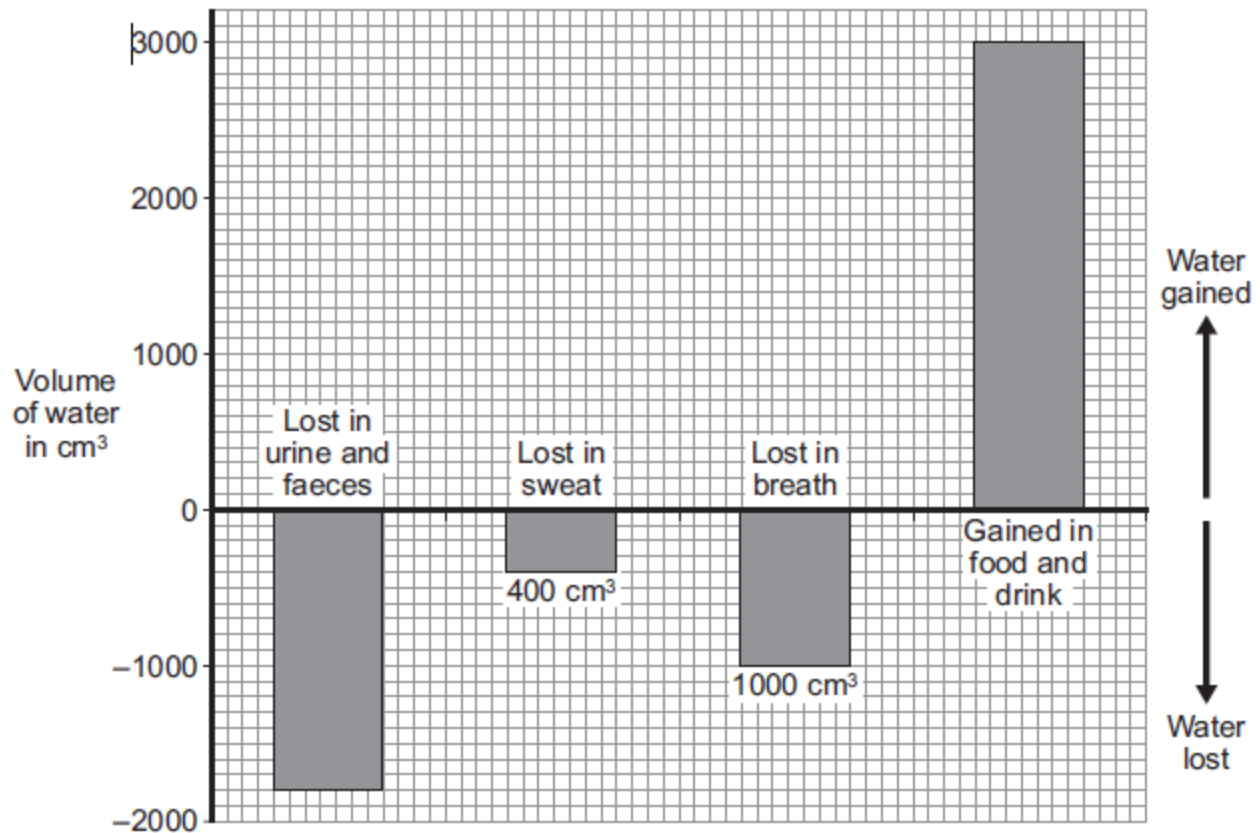
(1)

(Total 11 marks)

8

The bar chart shows different ways in which water is lost from and gained by the body on one day.

The volumes of water lost in the sweat and in the breath are labelled on the bars.



(a) How much water was lost in the urine and faeces? cm³

(1)

- (b) Water is lost from the body in urine, faeces, sweat and breath.

What was the total volume of water lost from the body on this day?

Show clearly how you work out your answer.

.....

.....

Answer = cm³

(2)

- (c) The volume of water lost should balance the volume of water gained.

What should the person do to balance the water gained with the water lost?

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.....

(2)

(Total 5 marks)

9

- (a) Urine contains mineral ions, and other substances, dissolved in water.

What effect will each of the activities in **Table 1** have on the concentration of mineral ions in the urine?

Use words from the box to complete **Table 1**.

increase	decrease	stay the same
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Table 1

Activity	Concentration of mineral ions in urine
Drinking a large bottle of water	
Eating salty foods such as potato crisps	

(2)

(b) A person with kidney disease may be treated by having a kidney transplant.

Table 2 shows the effect of a person’s age on the success of a kidney transplant.

Table 2

	Age of patient	
	50-59 years	Over 60 years
Percentage of kidneys rejected	38	23
Percentage of kidneys which continued to work for at least 5 years	82	87
Percentage of patients who survived for at least 10 years	82	76

Some doctors think that people over 60 years of age should not be given transplants.

From the data in the table, do you agree with these doctors?

Draw a ring around your answer. **Yes / No**

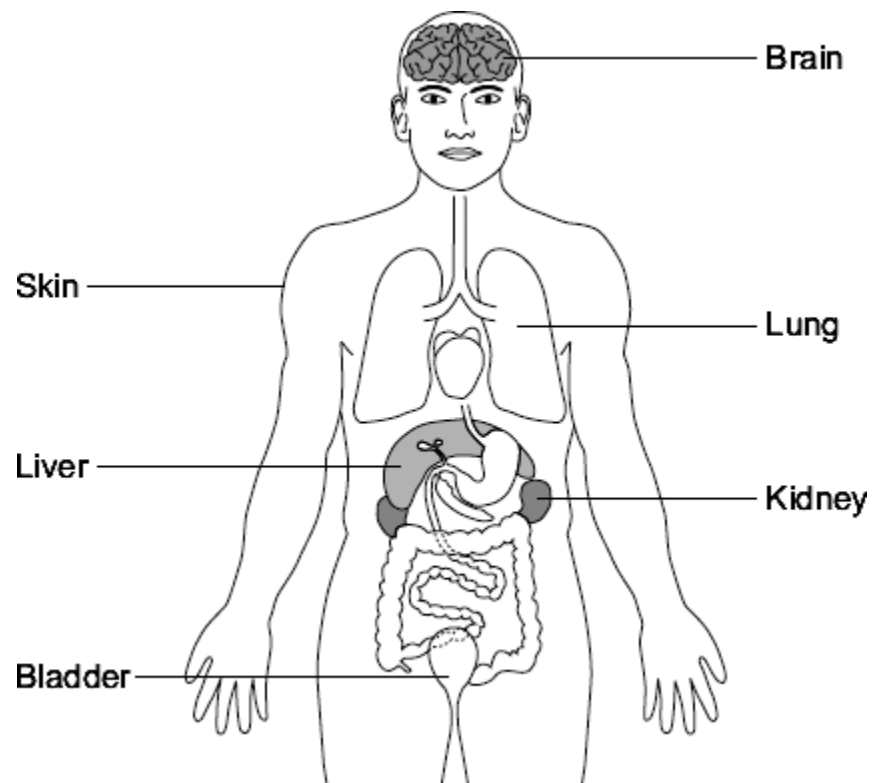
Give **two** reasons for your answer.

- 1
-
- 2
-

(2)
(Total 4 marks)

10

- (a) The diagram shows organs which help to control conditions inside the body.



Draw a ring around the correct answer to complete each sentence.

- (i) Carbon dioxide is removed from the body by the

kidney.
lung.
skin.

(1)

- (ii) Urine is made in the

kidney.
lung.
skin.

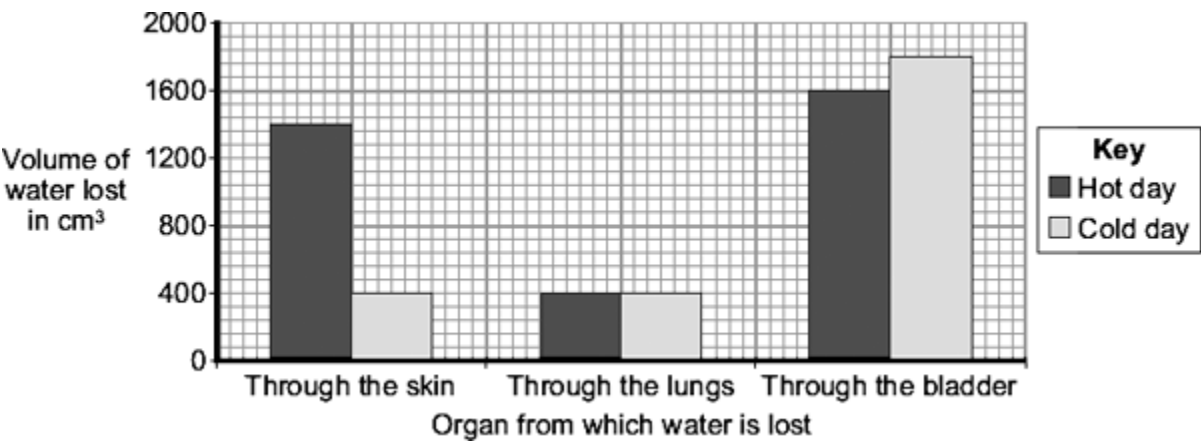
(1)

- (iii) Urine is stored in the

bladder.
liver.
skin.

(1)

- (b) The bar chart shows the volume of water lost from different organs of the body. The information is shown for a hot day and for a cold day.



- (i) Look at the bar chart.

How does the volume of water lost on the hot day compare with the volume of water lost on the cold day for each organ?

Complete the table using words from the box.

<div> <div>the same</div> <div>less</div> <div>more</div> </div>		
Organ	Volume of water lost on a hot day compared with volume of water lost on a cold day	
Skin		
Lungs		
Bladder		

(3)

- (ii) In total, more water is lost on the hot day than on the cold day.

How does the increase in the volume of water lost on the hot day help to control the body temperature?

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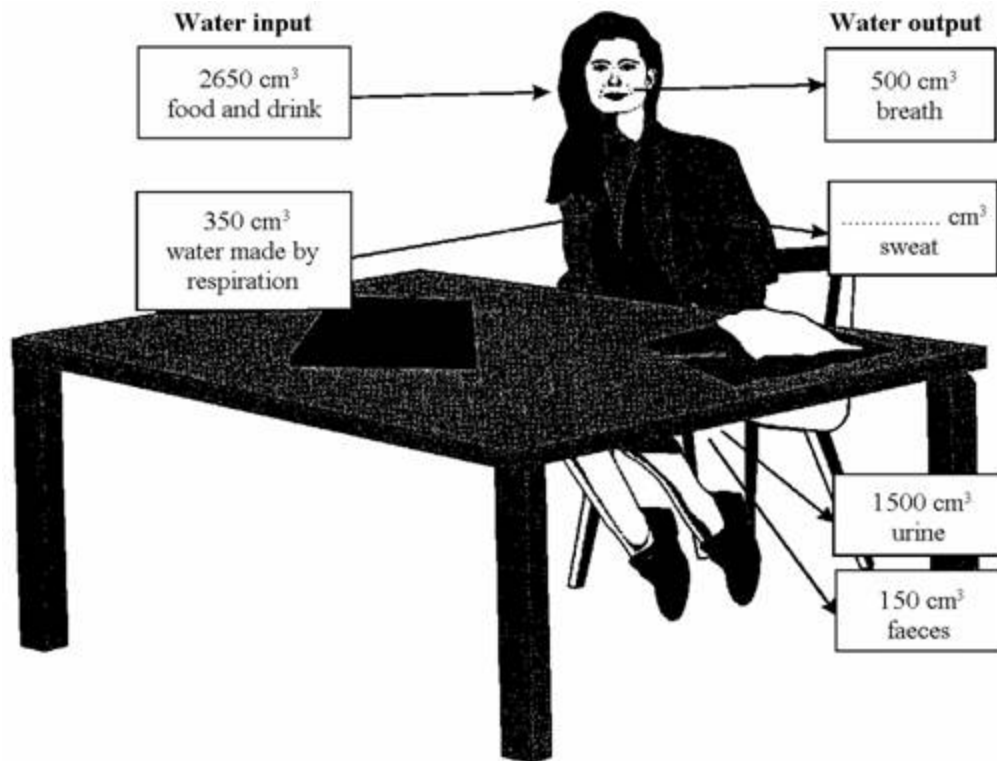
(1)

(Total 7 marks)

11

The diagram shows a water balance for a girl who spends most of the day working at a desk. It is not complete.

- (a) Complete the diagram by writing in the volume of sweat produced.



(1)

- (b) The next day she spent much of the day training, doing many different types of exercise.

State how **each** of the following would change and why it would be different from the previous day.

- (i) The amount of water given off as sweat.

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(2)

- (ii) The amount of water breathed out.

.....

(2)

- (iii) The amount of urine passed, if she had the same water intake as on the previous day.

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(2)

- (c) Which organ controls the amount of water in the body?

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(1)

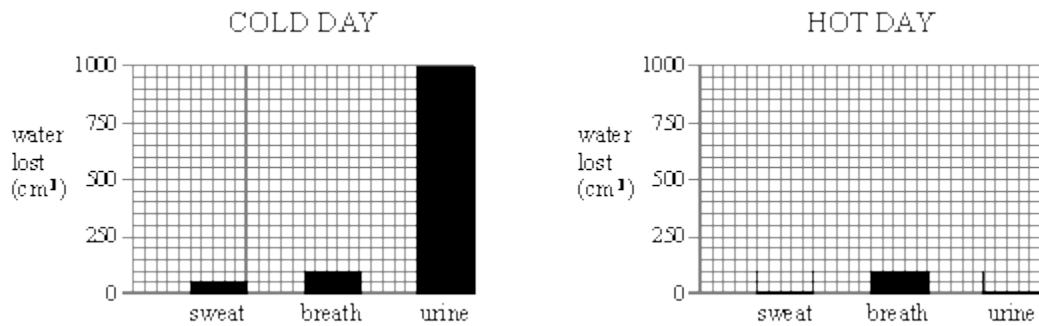
(Total 8 marks)

12

The table shows how much water is lost from a boy's body on a cold day and on a hot day.

WATER LOST (cm ³)	COLD DAY	HOT DAY
in sweat	50	300
in breath	100	100
in urine	1000	750

- (a) Use the figures in the table to complete the bar-chart for a hot day.



(2)

- (b) How do the figures for the hot day compare with those for the cold day?
Answer in as much detail as you can.

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(4)

- (c) The boy does the same things for the same amount of time on both days.
Explain why the amounts of water lost in sweat and urine change.

Sweat

.....

Urine

.....

(2)

(Total 8 marks)

13

The kidneys regulate the concentration of substances in the blood.

- (a) Glucose is found in the blood but not in the urine.

Describe the processes that prevent glucose being excreted in the urine.

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.....

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.....

(3)

- (b) The table shows the concentrations of dissolved substances in the urine of a healthy person and the urine of a person with one type of kidney disease.

Substance	Concentration in grams per dm ³	
	Urine of a healthy person	Urine of a person with kidney disease
Protein	0	6
Glucose	0	0
Amino acids	0	0
Urea	21	21
Mineral ions	19	19

- (i) Suggest an explanation for the difference in composition of the urine between the healthy person and the person with kidney disease.

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(2)

- (ii) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The person with the kidney disease could be treated either by using a dialysis machine or by a kidney transplant operation.

Compare the **advantages** and **disadvantages** of these two methods of treatment.

Use your knowledge and understanding of the two methods in your answer.

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(6)

(Total 11 marks)

14

- (a) Each day, a boy ate food containing 12 000 kilojoules of energy. The boy's body used 80 per cent of this energy to maintain his core temperature.

- (i) Name the process which releases energy from food.

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(1)

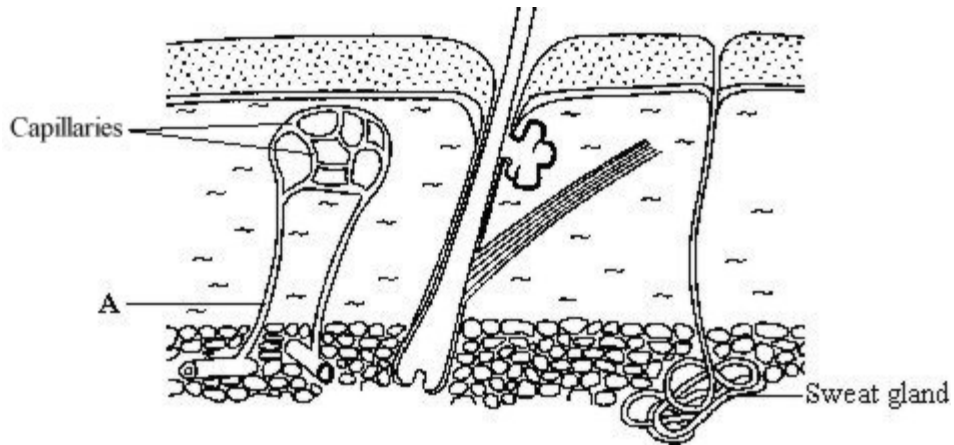
- (ii) Calculate the amount of energy that the boy would use each day to maintain his core body temperature. Show clearly how you work out your final answer.

.....

Amount of energy used each day = kJ

(2)

- (b) The diagram shows a section through human skin.



Explain how structure A helps to cool the body on a hot day.

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(3)

- (c) Body temperature is monitored and controlled by the thermoregulatory centre. Where in the body is the thermoregulatory centre?

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(1)

(Total 7 marks)

15

- (a) Explain how sweating helps to keep our body temperature relatively constant.

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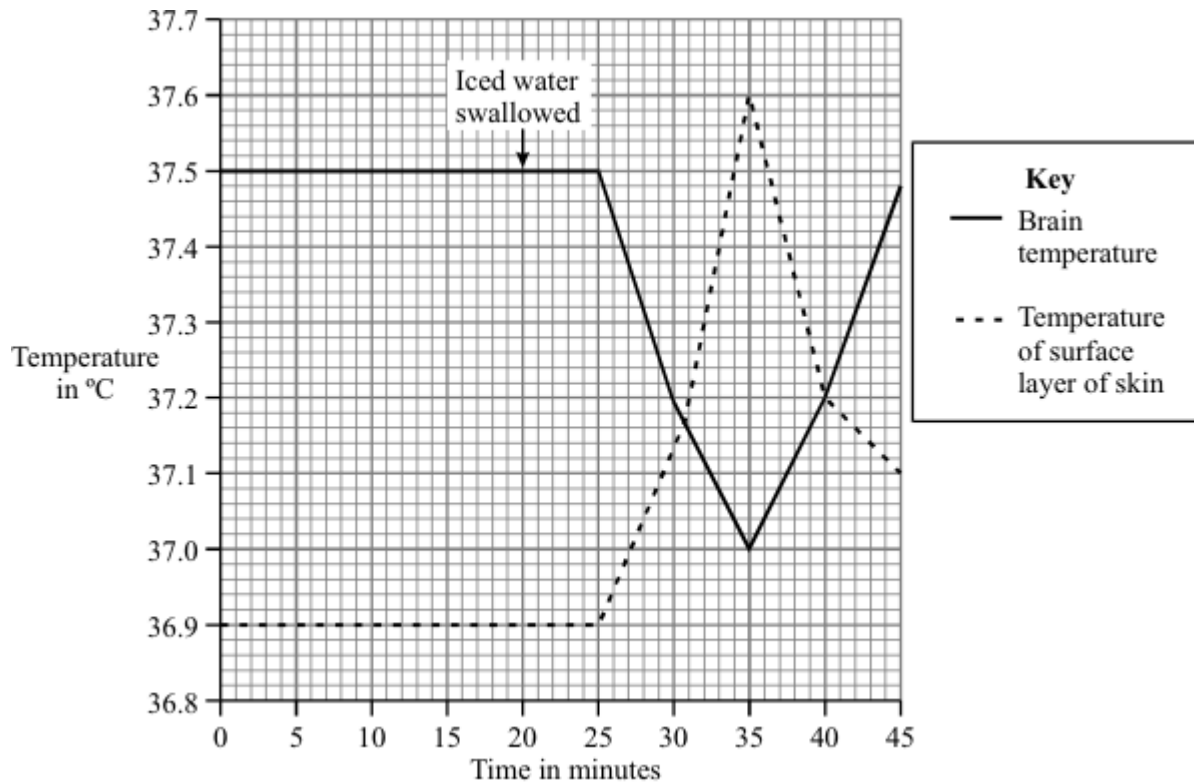
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(2)

- (b) In an experiment, a student swallowed some iced water. The graph shows how this affected the student's skin temperature and brain temperature.



- (i) Explain why the temperature of the brain changed after the student swallowed the iced water.

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(2)

- (ii) This change in brain temperature led to a change in the temperature of the surface layer of the skin.

Explain how this happened.

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(3)

(Total 7 marks)

16

- (a) Describe, as fully as you can, the job of

- (i) the circulatory system.

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(2)

- (ii) the digestive system.

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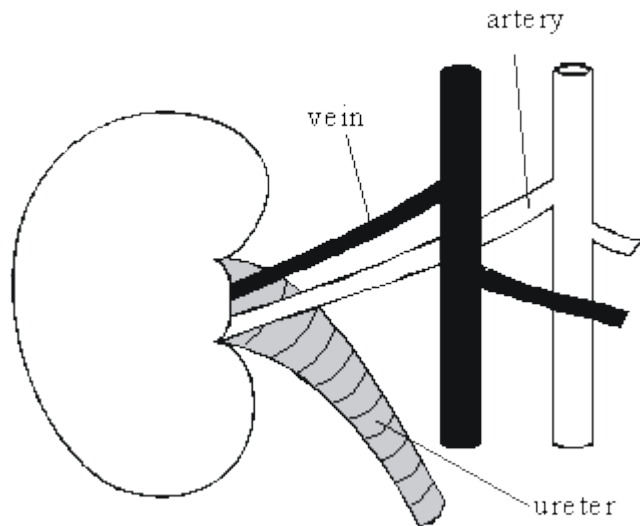
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(3)

(b)



The drawing shows a kidney, its blood supply and the ureter (a tube which carries urine from the kidney to the bladder). The amount and composition of the urine flowing down the ureter change if the blood in the artery contains too much water. Describe these changes and explain how they take place.

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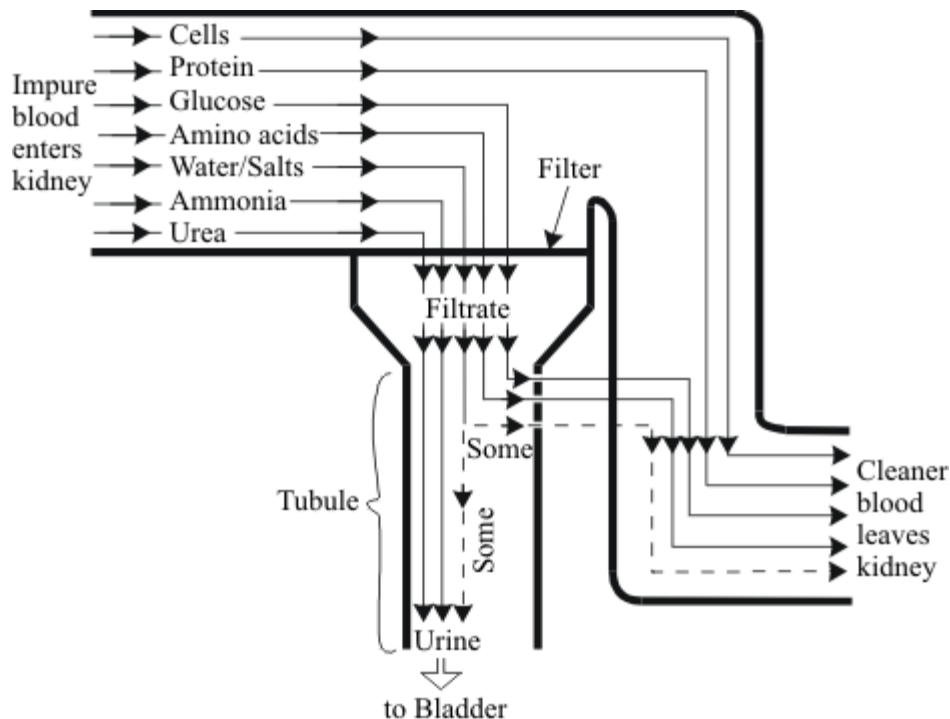
(4)
(Total 9 marks)

17

The job of our kidneys is to remove unwanted substances from our blood.

Substances which are needed in the blood must not be lost.

The flow-diagram below shows how the kidneys do this job.



(a) Describe what happens to the glucose and amino acids in the kidney.

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(4)

(b) A man has 5 litres of blood in his body.

- In one day:
- the kidneys filter out 170 litres of liquid from the blood.
 - he produces 1.5 litres of urine.

(i) What % of the filtered liquid is reabsorbed?

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(2)

- (ii) The man became ill because his kidneys would not absorb as much of the filtered liquid.

Write down **two** ways the man would be affected by this.

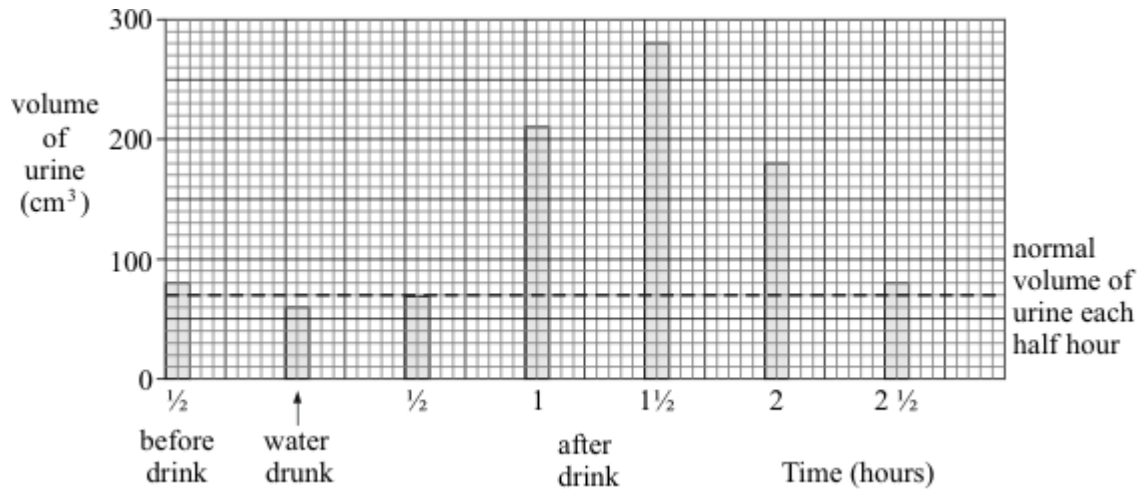
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(2)

- (c) In an experiment the man drank 800cm³ of water.

The diagram shows the effect this had on the volume of urine the man produced each 30 minutes.



Describe, in as much detail as you can, how drinking the water affected the volume of urine produced afterwards.

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(5)

(Total 13 marks)

18

Conditions inside the body must be kept constant.

(a) Urea must be removed from the body.

(i) Name the organ which makes urea.

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(1)

(ii) Which organ removes urea from the body?

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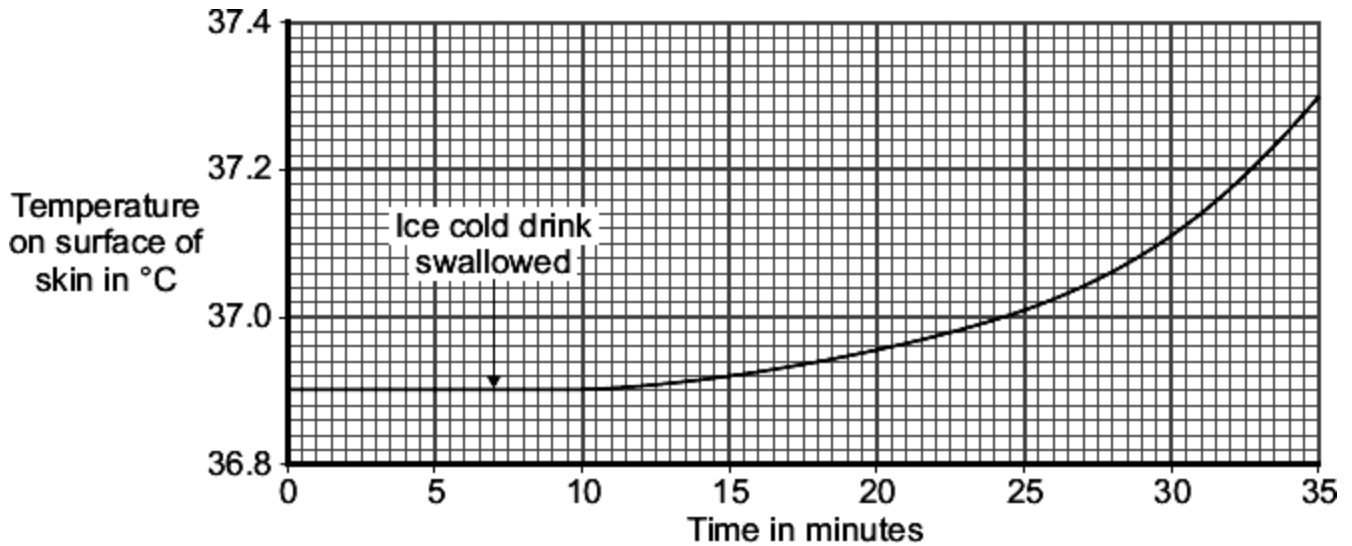
(1)

(iii) What is urea made from?

.....

(1)

A man sat in a room where the temperature was maintained at 40 °C. The temperature on the surface of his skin was monitored for 35 minutes. He swallowed an ice cold drink at the time indicated on the graph.



- (b) The sweat glands contribute to the change in the temperature on the surface of the skin shown on the graph.

Explain how.

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(2)

- (c) The blood vessels near the surface of the skin also contribute to the changes in skin temperature shown on the graph.

- (i) How do the blood vessels in the skin change when the core body temperature falls?

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(1)

- (ii) How does this change in the blood vessels explain the change in the skin temperature shown on the graph?

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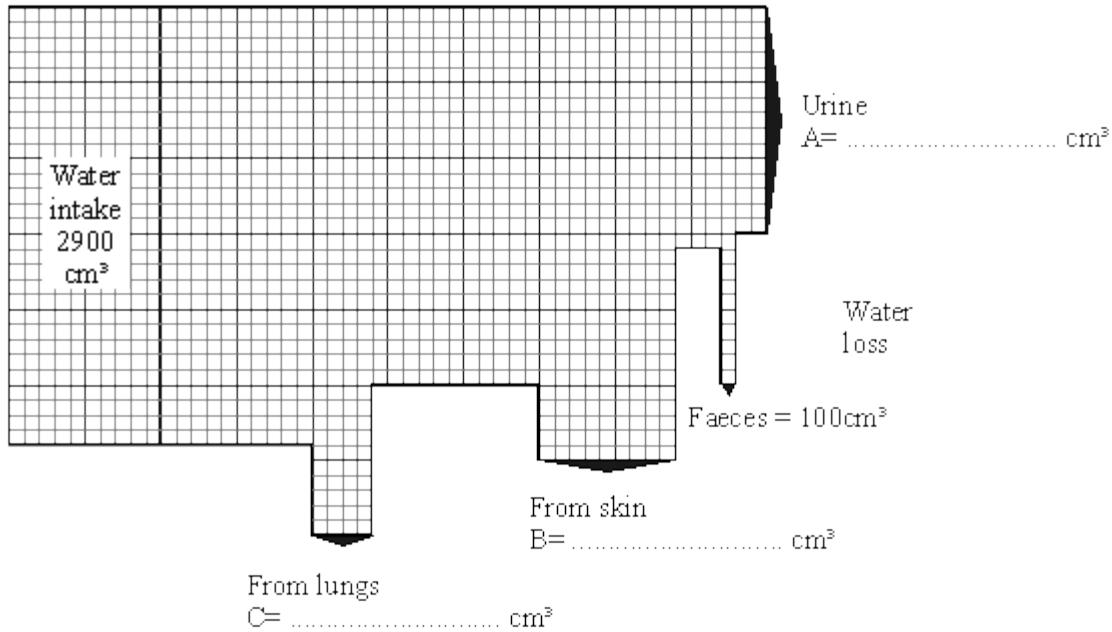
(1)

(Total 7 marks)

19

The diagram shows the amount of water lost by an adult in one day.

The width of the arrows shows how much water is lost in each way.



- (a) Work out from the diagram the water loss for urine, skin and lungs and write the correct figures in the spaces on the diagram.

(4)

- (b) When it is hot, much more water is lost from the skin. Which other method of water loss would also change significantly?

Explain your answer.

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(3)

(Total 7 marks)

20

The temperature in a sauna is much hotter than core body temperature.

A woman sits in a sauna.

The high temperature of the sauna causes the woman's core body temperature to rise.

(a) When the woman's core body temperature rises, the woman's rate of sweating increases.

Explain why.

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(2)

(b) The woman comes out of the sauna.

The woman's skin looks redder than when she went into the sauna.

Describe what happened to the blood circulation in her skin to cause this change in colour.

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(2)

(c) After coming out of the sauna the woman gets into a bath of icy water.

This makes the woman shiver.

(i) What process brings about shivering?

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(1)

(ii) Shivering increases body temperature.

Explain how.

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(2)

(Total 7 marks)

21

Use your knowledge of how the kidney works to answer the following questions.

- (a) Blood plasma contains mineral ions, glucose, urea and proteins.

Explain why urine contains mineral ions and urea, but **no** glucose or protein.

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(4)

- (b) A man ate and drank the same amounts of the same substances and he did the same amount of exercise on two different days. On one of the two days the weather was hot and on the other day the weather was cold.

The man’s urine contained a higher concentration of mineral ions and urea on the hot day than on the cold day.

Explain why.

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(4)

(Total 8 marks)

22

Diffusion and active transport take place in healthy kidneys.

(a) Explain what is meant by:

(i) diffusion
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(2)

(ii) active transport
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(2)

(b) Describe, as fully as you can, how urine is produced by the kidneys.

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(5)

(Total 9 marks)

23

Humans maintain an almost constant body temperature.

(a) Describe the role of blood vessels in the control of body temperature.

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(4)

(b) An athlete can run a marathon in 2 hours 15 minutes on a dry day in outside temperatures up to 35 °C.

If the air is dry, his body will **not** overheat.

In humid conditions the same athlete can run the marathon in the same time. However, in humid conditions, if the outside temperature goes over 18 °C then his body **will** overheat.

Suggest an explanation for the athlete overheating in humid conditions.

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(3)

(Total 7 marks)

24

Urine consists of water, ions and other substances such as urea.
Urine is formed in the kidney by filtering the blood.
The diameter of the pores in the filter is about 6 nanometres.

The table shows the diameters of the molecules of some of the substances in the blood.

Substance	Diameter of molecule in nanometres
A	10 to 20
B	1
C	0.6
D	0.5
E	0.2

Use information from the table and your own knowledge to answer the questions.

(a) (i) Which substance, **A**, **B**, **C**, **D** or **E**, is protein?

(1)

(ii) Protein is **not** found in the urine of a healthy person.

Explain why.

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(2)

- (b) Substance **B** is **not** found in the urine of a healthy person.
Suggest an explanation for this.

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.....

(2)

- (c) Haemolytic anaemia is a disease in which some of the red blood cells burst open.

Small amounts of haemoglobin may be found in the urine of a person suffering from haemolytic anaemia.

The diameter of a haemoglobin molecule is 5.5 nanometres.

Haemoglobin is **not** found in the urine of a healthy person, but haemoglobin can be found in the urine of a person with haemolytic anaemia.

Explain why.

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(Total 8 marks)

25

One group of scientists is working in a hot desert and another group is working in a tropical rainforest.

The table shows information about the scientists and the conditions in the desert and the rainforest.

Information	Hot desert	Rainforest
Mean core body temperature of scientists in °C	37.3	38.9
Air temperature in °C	36.0	35.5
Mean percentage concentration of moisture in the air	9.0	92.0
Mean wind speed at ground level in metres per second	12.0	3.0

- (a) Both groups of scientists are doing similar jobs. The jobs cause the scientists to sweat a lot.

Use information from the table to explain the difference in the mean core body temperature of the two groups of scientists.

.....

.....

.....

.....

.....

(2)

- (b) Changes to blood vessels in the skin help to decrease body temperature.

Explain how.

.....

.....

.....

.....

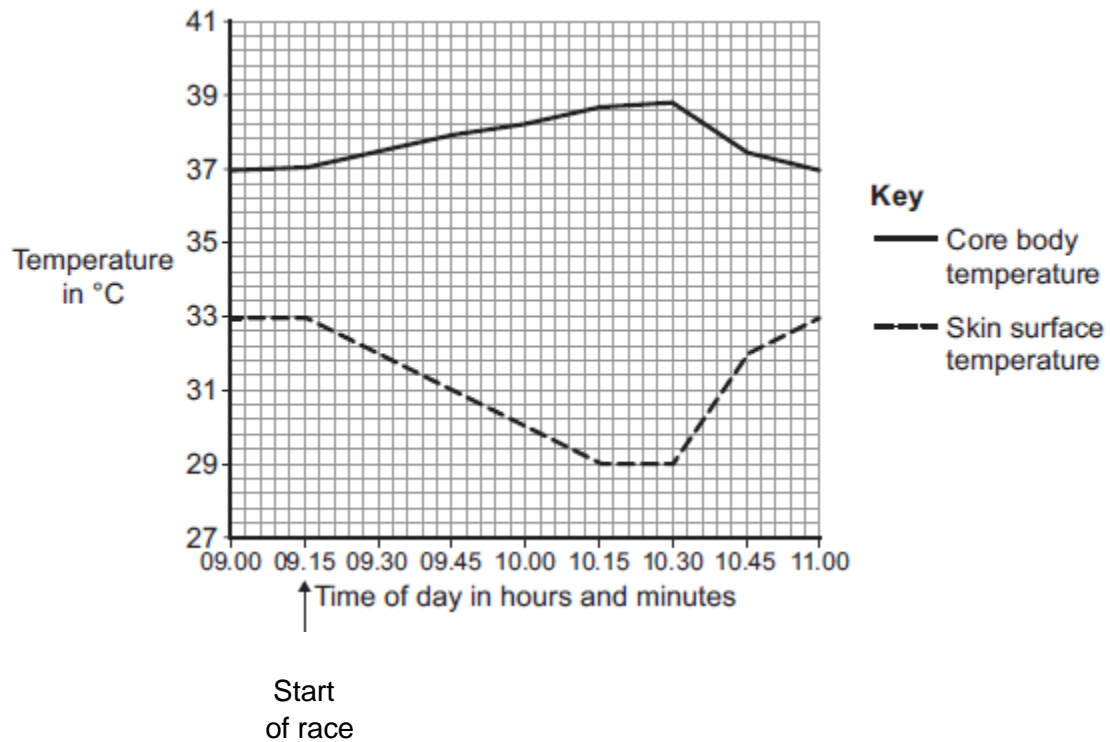
.....

(2)

(Total 4 marks)

26

The graph shows the core body temperature and the skin surface temperature of a cyclist before, during and after a race.



- (a) (i) When the cyclist finished the race, his core body temperature started to decrease.
How long did the race last?

.....

(1)

- (ii) Describe and explain the different patterns shown in the core body temperature and skin surface temperature between 09.15 and 10.15.

.....

.....

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.....

.....

.....

(6)

- (iii) After 10.30, the core body temperature decreased.

Explain how changes in the blood vessels supplying the skin caused the skin surface temperature to increase.

.....

.....

.....

.....

.....

.....

(2)

- (b) During the race, the cyclist's blood glucose concentration began to decrease.

Describe how the body responds when the blood glucose concentration begins to decrease.

.....

.....

.....

.....

.....

.....

.....

(3)

(Total 12 marks)

27

It is important that the amount of water in the body is controlled.

- (a) The table below shows the main ways that a person takes in and loses water in one day.

Water taken in		Water lost	
Method	Volume in cm ³	Method	Volume in cm ³
Drink	1450	Urine	1500
Food	800	Sweat	600
Metabolic water	350	Breath	
		Faeces	100
Total	2600	Total	2600

- (i) Calculate the volume of water lost from the body through breathing.

Use information from the table above.

Volume of water lost through breathing = cm³

(2)

- (ii) Metabolic water is water produced by aerobic respiration.

Complete the equation for aerobic respiration.

..... + oxygen \longrightarrow + water (+ energy)

(2)

- (iii) If the water intake stays the same, what will happen to the volumes of sweat and urine lost from the body on a much hotter day?

Draw a ring around the correct answer to complete each sentence.

The volume of sweat will

decrease.
increase.
stay the same.

The volume of urine will

decrease.
increase.
stay the same.

(2)

- (b) The kidneys help to control the water content of the body and the concentrations of substances dissolved in the body fluids. The kidneys do this by filtering the blood and then reabsorbing back into the blood the substances needed by the body.

The table above shows typical concentrations of some of the substances dissolved in a person's blood plasma, in the kidney filtrate, and in the urine.

Substance	Blood plasma in g per dm ³	Kidney filtrate in g per dm ³	Urine in g per dm ³
Protein	70	0	0
Glucose	1	1	0
Urea	0.3	0.3	20
Sodium ions	3	3	6

- (i) The table below shows that sodium ions are twice as concentrated in the urine as in the blood plasma.

Calculate how many times more concentrated **urea** is in the urine compared to the blood plasma.

Use information from the table.

.....
.....

Answer = times more concentrated

(2)

- (ii) What is the main cause of this increase in concentration of urea between the blood plasma and the urine?

Tick (✓) **one** box.

Increased urea production by the kidney

☐

Reabsorption of water by the kidney

☐

Increased deamination of amino acids by the liver

☐

(1)

- (iii) The table shows that both protein and glucose are found in the blood plasma but **not** in the urine.

Use your knowledge of kidney functioning to explain why.

Protein

.....
.....

.....

Glucose

.....
.....

.....

(4)

(c) Some people have kidney failure.

The two main types of treatment for kidney failure are dialysis and a kidney transplant operation.

Suggest reasons why most doctors think that a kidney transplant is better than dialysis treatment.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(Total 17 marks)

28

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

The human body is kept at a constant internal temperature of about 37 °C.

Body temperature is monitored and controlled by the thermoregulatory centre in the brain.

Describe what happens in the body to keep the body temperature constant.

.....

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Extra space

.....

.....

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.....

(Total 6 marks)

Mark schemes

1	<p>(a) (i) (37C is the same as human) body temperature</p>	1	[6]
	<p>(ii) any one from:</p>		
	<ul style="list-style-type: none"> • urea • glucose • sodium <p><i>ignore water</i></p>	1	
	<p>(iii) (as they are) small enough to pass through (the membrane)</p> <p><i>allow because there is a high concentration in the fake blood and a low concentration in the water (so will diffuse across)</i></p>	1	
	<p>(iv) glucose</p>	1	
	<p>(b) any two from:</p> <ul style="list-style-type: none"> • don't have to go to hospital or done at home rather than hospital • less effect on lifestyle / can be mobile • always filtering urea out <p><i>continuous is insufficient</i></p> <ul style="list-style-type: none"> • don't need a medical professional (to do it for you) <p><i>allow takes a shorter time</i></p> <p><i>allow does not have to be connected to blood vessels</i></p> <p><i>ignore 'less painful'</i></p>	2	
2	<p>(a) (i) 600</p>	1	[4]
	<p>(ii) more sweat produced on warm day / for cooling on warm day</p>	1	
	<p>(b) the volume of water in the urine decreases</p>	1	
	<p>the volume of water taken as food or drink increases.</p> <p><i>each extra box ticked cancels a mark</i></p>	1	
3	<p>(a) (i) 94.9</p> <p><i>correct answer with or without working</i></p> <p><i>if answer is incorrect 100 - (2.5 + 2.6) gains 1 mark</i></p>	2	

(ii) protein molecules in the plasma cannot pass through the filter in the kidney

1

(b) (i) partially permeable

1

(ii) the same as

1

(c) any **one** from

- hazards of operation / named example
- may be rejected / need to use immunosuppressant drugs / need to find (tissue) match
allow long term drug use
- not enough donors
allow a long waiting list
- transplants have a limited life

1

[6]

4

(a) any **one** from:

- (in) food / named
allow eating
- (from) respiration
*do **not** allow breathing*

1

(b) (i) the greater / heavier the body mass the more water (should be drunk)

ignore references to hot / cold day

accept positive (relationship)

ignore figures unqualified

1

(ii) 2200

1

(iii) 400

*award **2** marks for correct answer, irrespective of working*

*allow ecf from b(ii) for **2** marks*

*if no answer or incorrect answer: 2200 - 1800 **or** b(ii) - 1800 gains **1** mark*

2

(c) need to replace water lost / prevent dehydration / keep hydrated

idea of balancing input and output

1

from / by (more) sweat
ignore other losses

1

(d) kidney

1

[8]

5

(a) 94.8

1

(b) (i) to cool (the body) / maintain (body) temperature
*do **not** accept let out heat*

1

(ii) water **and** ions

1

(iii) water ignore CO₂, and vapour

1

(c) any **two** from:

used in respiration

provides energy

(energy) needed for movement / running / muscle action

2

[6]

6

(a)

glucose ☒

urea ☒

water ☒

sodium ions ☒

protein ☐

all 3 correct = 2 marks

2 correct = 1 mark

0 or 1 correct = 0 marks

max 2

(b) (i) protein cannot pass through filter

or

protein (too) large

or

protein stays in the blood

1

(ii) reabsorbed

1

(c) (i) less

1

(ii) more

1

[6]

7

(a) (i) kidney

1

(ii) bladder

1

(iii) liver

1

(iv) lung(s)

1

(v) skin

1

(b) (i) 3000

allow 2970 to 3030

correct answer gains 2 marks with or without working

if answer incorrect allow 1 mark for evidence of $1550 + 450 + 1000$

(allow tolerance of + or $-\frac{1}{2}$ square on each)

2

(ii) 1600

allow 1570 to 1630

1

(iii) 1400

allow (b)(i) – (b)(ii)

1

(iv) correct plot from (b)(iii)

tolerance $\frac{1}{2}$ square ignore width

1

- (v) cells swell / overhydrated /
damaged
accept poisoned (by urea)

1
[11]

8

- (a) 1800

allow - / minus 1800

1

- (b) 3200

award both marks for correct answer irrespective of working

allow - / minus 3200

award 2 marks for 200 or -200 irrespective of working

allow ecf from part (a) for both routes to 2 marks

*if no answer **or** incorrect answer then indication of addition of 1800
or their (a), 1000 and 400 gains 1 mark*

2

- (c) drink more / take in more from food & drink

*allow ecf from (b), ie if answer to (b) is less than 3000 then accept
drink less*

if answer to (b) is exactly 3000 accept do nothing

1

200 (cm³)

*accept ecf from (b) answer should be difference between (b) and
3000 if answer to (b) is 3000 accept they are the same*

NB drink / take in 3200 (cm³) of water = 1 mark

drink / take in 200 (cm³) of water = 2 marks

ignore references to exercise / sweat

1

[5]

9

- (a) in table, in sequence:

allow descriptions for increase / decrease

decrease

1

increase

1

(b) **No**

older have lower % / less chance of rejection (than younger) (1)

allow figures

older have higher % / more chance of still working (after 5 years than younger)

allow figures

allow in older patients kidney works for longer

1

or

Yes

allow max 1 mark if Yes

older have lower % / less chance of surviving (at least 10 years than younger)

allow older people are more likely to die

1

[4]

10

(a) (i) lung

1

(ii) kidney

1

(iii) bladder

1

(b) (i) more

1

the same

1

less

allow synonyms

1

(ii) cools / reduces temperature

or

prevent overheating

ignore reference to sweat

1

[7]

11

(a) 850

1

(b) (i) more

because exercise makes us sweat **or** work harder
accept to cool the body
do not credit body hotter or giving off more heat

2

(ii) more

because she respire more
*accept she breathes (in and out) more **or** heavier **or** faster*

2

(iii) less

because (more) water has been lost by sweating **or** breathing out **or** other methods
accept arguments about conservation of water

2

(c) kidney

1

[8]

12

(a) sweat – 6 squares high
urine – 15 squares high

each to < half a square for 1 mark each

2

(b) for hot day (assumed unless otherwise stated)

- same in breath
- same total
- more in sweat* / sweats more
- less in urine* / urinates less
- correct quantification of either * eg $x\text{cm}^3$ more / less or n times more / less
250 cm^3 more sweat 6 × more sweat
250 cm^3 less urine ¼ / 25% less urine
any four • for 1 mark each
[Do not allow just figures quoted from the table]

4

(c) *ideas that*

- you sweat more **to keep cool** on a hot day
- urine adjusted (by kidneys) to keep balance / to keep same total loss
each for 1 mark
[Accept "more sweat therefore less urine"]
[Credit ideas from (c) if given in (b)]

2

[8]

13

(a) glucose is filtered out of the blood

1

the filtered glucose is then taken back into the blood / reabsorbed
*allow absorbed into the blood but **not** absorbed unqualified*

1

by active transport

1

(b) (i) *in a healthy person*

protein not present because proteins are large (molecules)
or

because cannot pass through (filter)

1

in person with disease

the 'filter' allows protein through

1

(ii) Marks awarded for this answer will be determined by the
Quality of Written Communication (QWC) as well as
standard of the scientific response.

No relevant content.

0 marks

There is a brief description of the two methods of treatment.
There is at least one disadvantage or advantage from
the examples given.

Level 1 (1–2 marks)

There is a scientific **comparison** of the two methods of
treatment, including at least one advantage and one
disadvantage but there is a lack of clarity and detail.

Level 2 (3–4 marks)

There is a clear and detailed scientific **comparison** of
the two methods of treatment, including at least two
advantages and two disadvantages.

Level 3 (5–6 marks)

examples of biology points made in the response

advantages of transplant over dialysis

- no build-up of toxins / keeps blood concentration constant
- prevent high blood pressure
- don't need restricted diet / restricted fluid intake or time wasted on dialysis
- blood clots may result from dialysis
- infection may result from dialysis
- with dialysis, blood may not clot properly due to anti-clotting drugs
- cost issues (ie transplant cheaper)

disadvantages of transplant over dialysis

- rejection / problem finding tissue match
- use of immuno-suppressant drugs leading to other infections
- dangers during operation

[11]

14

(a) (i) respiration

1

(ii) 9600

if correct answer, ignore working / lack of working

$$\frac{80 \times 12000}{100} \text{ for 1 mark}$$

2

(b) any **three** from:

- dilates / widens **or** muscle in wall relaxes **or** sphincter opens
*do **not** accept expands or just gets bigger*
- more blood flows near skin surface **or** more blood through capillaries
- heat lost by radiation / convection / conduction
ignore evaporation
- heat loss from blood / cools blood

3

(c) hypothalamus / brain

1

[7]

15

- (a) evaporation of sweat

*do not credit sweating cools body if no
reference to evaporation*

1

cools body

*allow cools body if attempt at
description of evaporation (e.g .sweat
dries) for 1 mark*

1

- (b) (i) idea blood (passing through gut)
cooled (by ice)

1

(this) cooled blood cools brain
do not credit ice cools brain

1

- (ii) impulses from brain /
thermoregulatory centre to skin
*do not accept messages / signals
accept hypothalamus
accept electrical signals*

1

vessels supplying skin surface
capillaries constrict / sweat glands less
active or hairs become erect
*do not credit capillaries constrict / move
down
accept reduced supply of blood to skin
surface
shivering (unqualified) is neutral*

therefore less heat lost by skin

2

[7]

16

- (a) (i) transport of substances **or** named substance **or** blood around the body
each for 1 mark

2

- (ii) breaks down (**not digests**) food absorption (into blood)
each for 1 mark

3

- (b) water filtered from blood
smaller proportion reabsorbed
therefore larger volume
of dilute urine produced
each for 1 mark

4

[9]

17

- (a) *idea:*
filtered

for 1 mark

reabsorbed

gains 1 mark

but

all reabsorbed

gains 2 marks

correct reference to blood

for 1 mark

4

- (b) (i) *evidence of* $\frac{170 - 1.5}{170} \times 100$

gains 1 mark

but

99(.1)(%)

gains 2 marks

2

- (ii) *idea:*
more urine

for 1 mark

body dries out/dehydrates

or

needs to drink more

for 1 mark

2

- (c) no effect for first half hour/until 1 hour
 rises to 210cm^3 /to 3x level after 1 hour
 rises to 280cm^3 /to 4x level after $1\frac{1}{2}$ hour
reference to 280cm^3 /1½ hour as maximum level
 falls to (near) normal after $2\frac{1}{2}$ hours
 comparison of rates of change e.g. rapid then slower rise and/or steady fall
 not all of 800cm^3 excreted (extra to normal)

each for 1 mark to max. of 5
(do not credit simply rises then falls)

5

[13]

18

- (a) (i) liver

1

- (ii) kidney

allow urethra / bladder

ignore ureter

1

- (iii) (excess) protein / named / amino acids

accept amino / ammonia

1

- (b) less / no sweating

allow ideas of how sweat glands change in order to reduce sweating

1

less heat lost / evaporation

1

- (c) (i) become narrower / constrict

allow contract / get smaller etc

allow less blood flows through vessels

*do **not** allow capillaries become narrower **or** reference to movement of vessels*

1

- (ii) reduced / no heat loss

allow heat gained from room

1

[7]

19

- (a) $A > B > C$;
 $A + B + C = 2\,800$;
one number correct
two numbers correct
each for 1 mark

4

- (b) urine;
less produced;
kidneys absorb more water
or
to maintain (water) balance
each for 1 mark

3

[7]

20

- (a) any **two** from
- reference to role of thermoregulatory centre detecting rise in temperature (of blood or skin) **or** / causing increase in sweating
 - more evaporation
*need to refer to more at least once to gain **both** marks*
 - more cooling / heat loss
without reference to more only award max 1 mark if both ideas given, eg cooling alone gets no marks

2

- (b) blood vessels supplying (skin) capillaries
*do **not** accept capillaries / veins*

1

or

arteries

or

arterioles

1

dilate / widen

allow vasodilation

do not accept idea of blood vessels moving

note: marks are awarded independently

accept shunt vessels close for 2 marks

1

- (c) (i) muscle contraction
ignore relaxing
*do **not** allow vasoconstriction*

1

(ii) respiration

(respiration) releases / produces heat

reference to respiration is required for this mark

1

[7]

21

(a) proteins are not filtered

1

glucose is filtered and (re)absorbed

allow glucose (completely) reabsorbed

1

ions are filtered and some (re)absorbed

allow some ions are reabsorbed

1

urea is filtered [and some / none (re)absorbed]

allow some / no urea is reabsorbed

1

(b) more / a lot of sweating occurred

accept converse arguments for cold day

1

more / a lot of water loss (by sweating)

1

more / a lot of water reabsorption / more water absorption by the kidney

1

lower volume of urine

allow less urine / less water in urine

1

[8]

22

(a) (i) movement of atoms / molecules / ions

accept particles

allow dissolved substances

ignore reference to membranes

1

(substance) moves from high to low concentration

allow down the gradient ignore

across / along / with a gradient

1

(ii) any **two** from:

- movement of molecules / ions
accept particles
allow dissolved substances this point once only in (a)(i) and (a)(ii)
- from low to high concentration
allow up / against the gradient
ignore across / along / with a gradient
- requires energy / respiration
accept requires ATP

2

- (b) • **filtration** of blood **or**
described re small (molecules)through / large not
ignore diffusion

1

max **four** from:

- **reabsorption** / substances taken back into blood
- (reabsorption) of all of the sugar / glucose
- (reabsorption) of some of ions / of ions as needed by body
- (reabsorption) of some of water / of water as needed by the body
- urea present in urine
accept urea not reabsorbed
- reabsorption of water by osmosis / diffusion **or** reabsorption of sugar / ions by active transport

4

[9]

23

- (a) if body temperature too high blood vessels supplying skin (capillaries) dilate / widen
*do **not** accept capillaries / veins dilate/constrict*

1

if body temperature is too low blood vessels supplying skin (capillaries) constrict / narrow

*do **not** accept idea of blood vessels moving (through skin)*

1

ignore expand

accept arteries / arterioles for 'blood vessels'

if no reference to skin allow blood vessels dilate and blood vessels constrict for one mark

so more / less blood flows through skin (capillaries) or nearer the surface of the skin
must correctly relate to dilation or constriction

1

so more / less heat is lost (from the skin by radiation)
must correctly relate to dilation or constriction

1

(b) sweat released

1

cannot evaporate because of high humidity / all the water vapour in the air

1

so less heat lost / less cooling

or

it is evaporation of sweat that cools the body

1

[7]

24

(a) (i) **A**

1

(ii) (protein) molecule is large
ignore letters

1

cannot pass through filter
(protein is) too big to get through the filter = 2 marks

1

(b) **B** is taken back into the blood **or**
B is reabsorbed

1

reabsorbed completely

or reabsorbed after filtration

1

(c) RBC is too big to pass through filter

1

Haemoglobin is inside red blood cells
or haemoglobin released when RBC bursts

1

Haemoglobin is small enough to pass through filter

or haemoglobin diameter < pore diameter

1

[8]

25

(a) in rainforest:

accept converse

(water from) sweat does not evaporate (as much)

max 1 if not clear whether desert or rainforest

1

any **one** from:

- (due to) less wind / higher moisture / humidity
- less cooling effect

ignore references to temperature

1

(b) blood vessels supplying capillaries dilate / widen **or** vasodilation

*do **not** award mark if candidate refers only to blood vessels dilating
or to capillaries dilating.*

*accept 'arteries' or 'arterioles' for 'blood vessels supplying,
capillaries' but do **not** accept 'veins'.*

ignore expand / get bigger / relax / open

*do **not** accept idea of blood vessels moving*

1

more blood (through skin / surface capillaries) leads to greater heat loss

1

[4]

26

(a) (i) 1 hour 15 mins / 1.25 hours / 75 mins

allow 1:15

ignore 1.15 hours

1

(ii)	increase in (core / body) temperature	
	<i>ignore numbers</i>	1
	(due to an) increase in <u>respiration</u> or more <u>muscle</u> contraction	1
	releasing energy (as a waste product)	
	<i>allow produces 'heat'</i>	
	<i>do not allow making energy</i>	1
	skin temperature decreases	1
	(because there is) sweating	1
	(which) evaporates and cools the skin	
	<i>ignore references to vasodilation or vasoconstriction</i>	1
(iii)	(there is) dilation of vessels (supplying skin capillaries)	
	<i>allow vasodilation</i>	
	<i>allow blood vessels widen</i>	
	<i>ignore expand</i>	
	<i>do not accept dilating capillaries or moving vessels</i>	1
	(so) more blood flows (near skin) (surface) or blood is closer (to the skin)	
	<i>ignore ref to heat</i>	1
(c)	pancreas detects (low) blood glucose	1
	produces glucagon	
	<i>do not allow glucagon made in the liver</i>	1
	(so) glycogen is converted to glucose	
	<i>allow adrenaline released which increases conversion of glycogen to glucose</i>	
	or	
	<i>reduced insulin production so less glucose into cells / less glucose converted to glycogen</i>	
	<i>for 1 mark</i>	1

[12]

27

(a) (i) 400

correct answer = **2** marks with or without working

$$2600 - (1500 + 600 + 100)$$

or

$$2600 - 2200$$

for **1** mark

2

(ii) LHS: glucose

accept $C_6H_{12}O_6$ / $C_6H_{12}O_6$ / sugar

1

RHS: carbon dioxide

accept CO_2 / CO_2

do **not** accept CO^2 / CO

1

(iii) (sweat) increase

1

(urine) decrease

1

(b) (i) 66.7 / 66.67 / $66\frac{2}{3}$ / 66.6 / 67

accept answers in range

correct answer = **2** marks with **or** without working

or

$$\frac{20}{0.3} \text{ for 1 mark}$$

or 66 / 66.6 / 66.66 / 66.67 / 67.0 for 1 mark

(penalise excessive number of sig. figs. -1 mark) (eg no more than 2 decimal places)

2

(ii) reabsorption of water by the kidney

1

(iii) (protein) (too) big

1

cannot pass through filter / stays in blood / cannot enter kidney tubule

1

(glucose) small / can pass through filter

1

all taken back into blood / all reabsorbed

allow the glucose is reabsorbed

1

(c) any **four** from:

- transplant is permanent / dialysis is repetitive treatment / dialysis only short term
- kidney works all the time / dialysis intermittent
- concentrations in blood kept (\pm) constant / substances build up in blood between dialysis sessions
- poisoning / damage to body by build-up of substances (with dialysis)
- danger of infection / damage to blood vessels by needles (with dialysis)
- risk of blood clots with dialysis or anticlotting drugs (can lead to blood loss)
- long term expense of dialysis / excessive use of health service resources
- social point – inconvenience of dialysis described – can eat or drink without constraint with transplant

4

[17]

28

Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks

No relevant content.

Level 1 (1 – 2 marks)

There is a description of thermoregulation **or** at least one correct mechanism (skin, sweat glands or muscles) but roles may be confused.

Level 2 (3 – 4 marks)

There is a description of thermoregulation **or** some correct mechanisms (sweating, shivering, blood flow in the skin).

Level 3 (5 – 6 marks)

There is a clear description of thermoregulation by TC or skin **and** some correct control mechanisms.

examples of biology points made in the response:

full marks may be awarded for detailed description of what happens if the core temperature is either too high or too low

- temperature receptors in TC
- the TC detects (core) body / blood temperature
- temperature receptors in the skin send impulses to the TC, giving information about skin temperature
- if the core body temperature is too high: blood vessels / arterioles supplying the skin capillaries dilate / vasodilation

***do not** accept refs to veins instead of arterioles or answers that imply blood vessels have moved up / down through the skin.*

- so that more blood flows (through the skin) and more heat is lost
- sweat glands release more sweat to cool the body
- by evaporation
- if the core body temperature is too low: blood vessels supplying the skin capillaries constrict
- to reduce the flow of blood (through the skin) and less heat is lost
- *allow idea of blood diverted to vital organs in extreme cold*
- muscles may shiver to release (heat) energy
- from respiration, some of which is lost as heat

[6]