

OCR GCSE GATEWAY BIOLOGY A • J247

BIOLOGY



EXAM QUESTION PACK

B3.3 MAINTAINING INTERNAL ENVIRONMENTS

SCORE

/190

PERCENTAGE

%

STEMUP

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Gateway Biology A (9-1)

Maintaining internal environments

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:

Additional resources may be supplied with this paper.

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate
forename

Candidate
surname

Centre number

Candidate number

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **190**.
- The total number of marks may take into account some 'either/or' question choices.

- 1 Probash is ill and is having tests in hospital.

His doctors monitor his body temperature frequently.

Explain why it is important to monitor Probash's body temperature frequently.

----- [2]

- 2 One treatment for heart valve problems is to lower the patient's blood pressure.

To lower the blood pressure, a drug can be taken to **increase** the amount of water excreted by the body.

Which organ would be targeted by the drug and what effect would it have on the urine?

organ -----

effect on urine -----

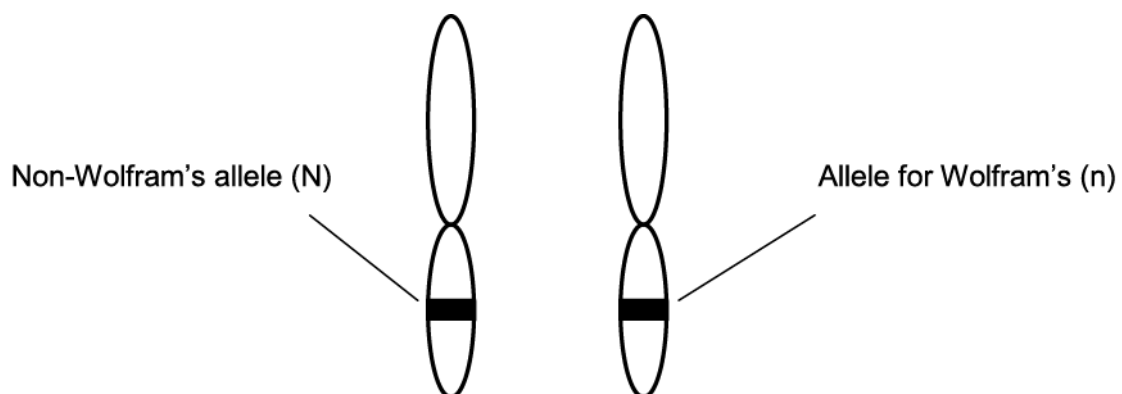
----- [2]

- 3 Wolfram's Syndrome is a genetic disorder.

It is caused by a recessive allele (n).

In people with Wolfram's syndrome, a protein does not function correctly.

The diagram shows a pair of chromosomes from a person called Tim.



(i) Meena is expecting a baby.

Tim is the father.

Complete this genetic diagram.

		Tim	
Meena	N		
	n		

[2]

(ii) Wolfram's syndrome can affect the production of hormones from the pancreas.

Meena and Tim's doctor tells them that there is a chance that their baby will have problems controlling its blood glucose level.

Explain why the doctor thinks this.

Use information from part (i) and your biological knowledge.

[4]

4 Which reduces heat transfer from the skin?

- A shivering
- B sweating
- C vasoconstriction
- D vasodilation

Your answer

☐

[1]

5 If ADH levels rise, how will this affect urine?

- A higher concentration of urea
- B higher volume
- C lower concentration of sodium chloride
- D more dilute

Your answer

☐

[1]

6 Scientists have tested the genes of a number of people who have diabetes.

They have found that there are about four different versions of a gene that can cause diabetes.

Why might this discovery be important?

- A Diabetes cannot be treated at the current time.
- B Different patients with diabetes can be given different drugs.
- C All types of diabetes can be treated by changing the diet.
- D Glucagon injections will be able to treat these four types of diabetes.

Your answer

☐

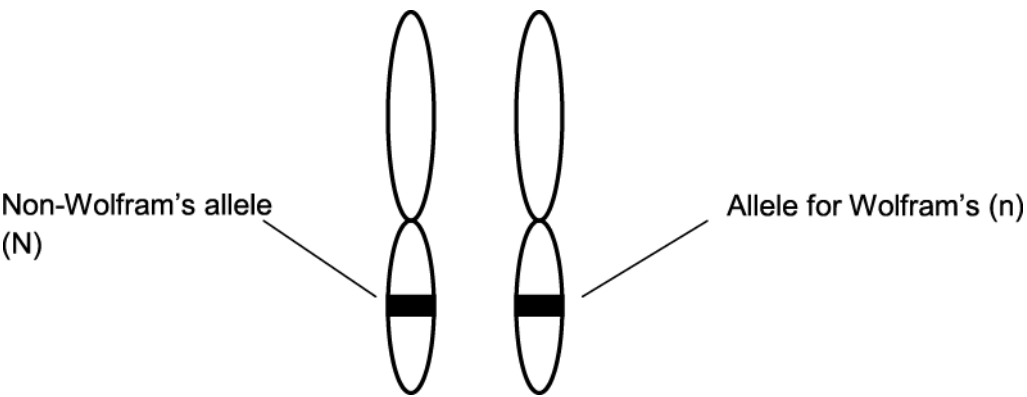
[1]

7 Wolfram's Syndrome is a genetic disorder.

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		Tim	
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	n		

[2]

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Explain why the doctor thinks this.

Use information from part (i) and your biological knowledge.

[4]

8 Singapore is a small country.

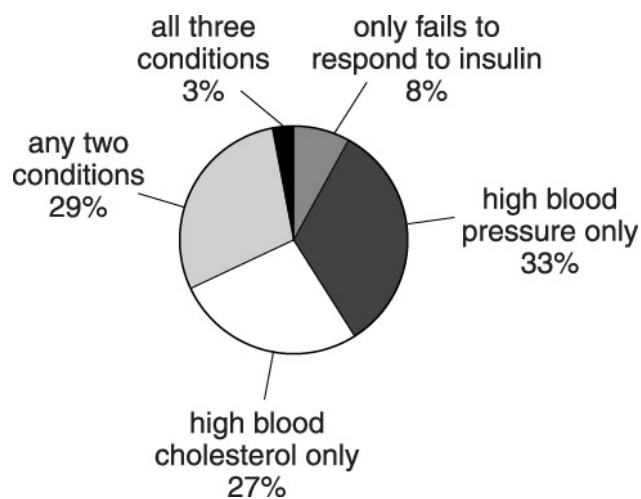
Everyone living in Singapore was offered a health check to test for three conditions.

They were tested:

- for high blood pressure
- for high levels of blood cholesterol
- to see if they failed to respond to insulin.

The check found that one million people had at least one of these conditions.

The pie chart shows the results for these one million people.



The government is worried about the possible consequences of these results for many of the people.

Explain the most serious consequences of these results for the health of the people.

Use calculations to support your answer.



The quality of written communication will be assessed in your answer to this question.

[6]

- 9 Sweat glands in the skin release sweat.

Explain how sweat can cool the body down.

[2]

10 One of the symptoms of malaria is a fever.

In a fever, the body temperature may rise to over 40 °C.

(i) How does the body monitor the rise in body temperature?

-----[2]

(ii) One way to cool down is by vasodilation.

Explain how vasodilation cools a body.

-----[2]

11 Malaria causes a fever.

The body temperature is very high during a fever and this may cause death.

Describe how high body temperatures can cause death.

-----[2]

12 Singapore is a small country.

Everyone living in Singapore was offered a health check to test for three conditions.

They were tested:

- for high blood pressure
- for high levels of blood cholesterol
- to see if they failed to respond to insulin.

The check found that one million people had at least one of these conditions.

A pie chart illustrating the distribution of conditions in the study population. The chart is divided into five segments, each with a label and a percentage. The segments are: 'high blood pressure only' (33%, dark grey), 'high blood cholesterol only' (27%, white), 'any two conditions' (29%, light grey), 'only fails to respond to insulin' (8%, medium grey), and 'all three conditions' (3%, black). Lines connect the labels to their respective segments.

Condition	Percentage
high blood pressure only	33%
high blood cholesterol only	27%
any two conditions	29%
only fails to respond to insulin	8%
all three conditions	3%

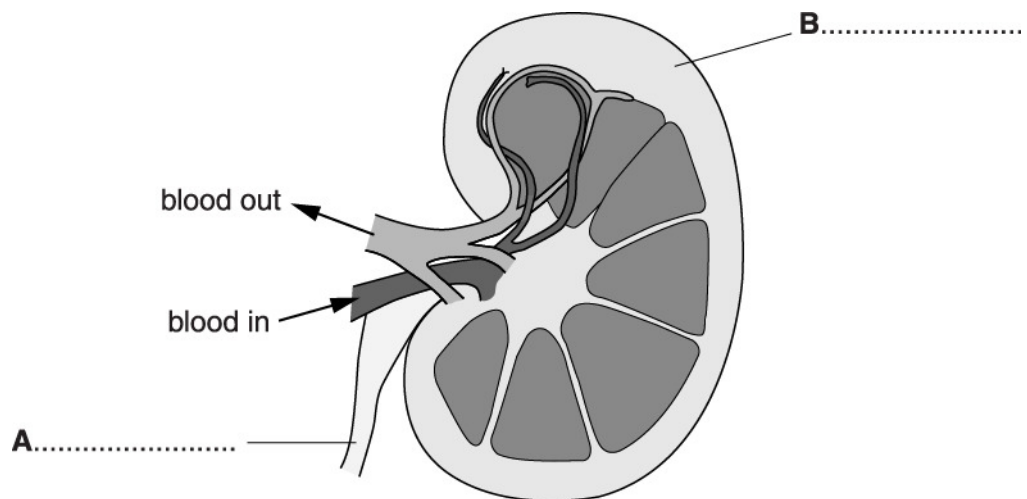


[6]

-----[1]

14 Kidneys are important organs in excretion.

The diagram shows a section through a kidney.



(i) Finish the diagram by adding the names of parts A and B.

[2]

(ii) It is important that the blood entering the kidney is at high pressure.

Write down why this is important for the correct working of the kidney.

-----[1]

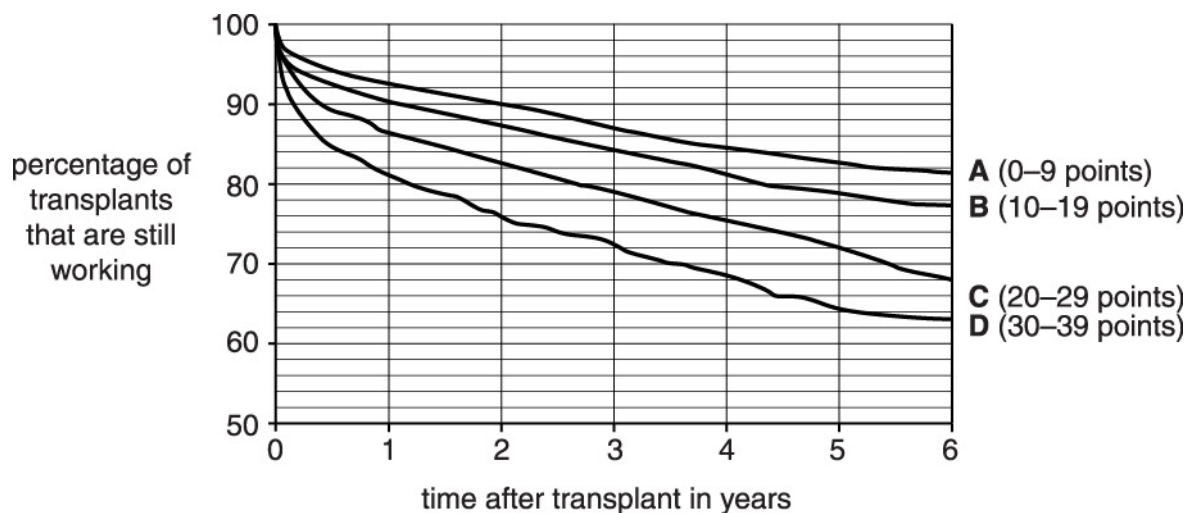
15(a) A person may donate one of their kidneys.

Before they do this they are marked on a Donor Scoring System.

This gives them points for different factors such as their age.

The points are added up and turned into a grade A, B, C or D.

The graph shows the effect of the grade on the success of a transplant.



Describe the patterns shown in the graph.

----- [2]

(b) Kidneys are important organs in excretion.

Manjit and Georgina are each going to donate a kidney.

These are their donor score sheets.

Manjit		Georgina	
Feature	Points scored	Feature	Points scored
43 years old	10	52 years old	15
renal function	2	renal function	2
blood pressure	3	blood pressure	3
tissue antigens	2	tissue antigens	2
body mass 65 kg	0	body mass 95 kg	1
Total points	17	Total points	

Georgina and Manjit both donate a kidney.

After 5 years, their donated kidneys have a different percentage chance of still working.

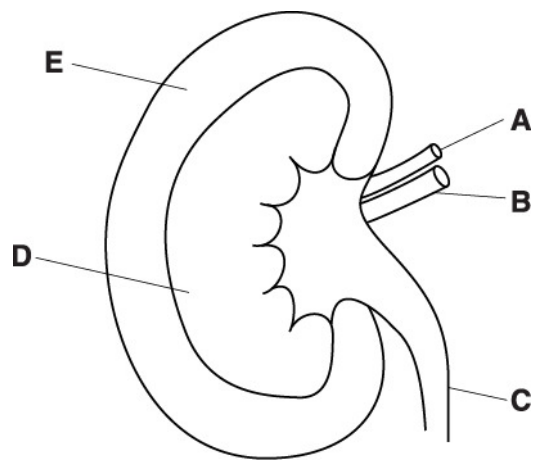
What is the difference between these two percentages?

Use the tables and information in the graph.

[2]

16(a) This question is about how the body controls urine concentration.

Look at the diagram of a kidney.



Match each letter to the correct part of the kidney.

One has been done for you.

Part of the kidney	Letter
cortex	
medulla	
renal artery	A
renal vein	
ureter	

[2]

(b) Water intake affects urine concentration.

Alcohol reduces the amount of anti-diuretic hormone (ADH) released.

Drinking 2 litres of either water or alcoholic beer will make the urine more dilute.

However, the urine concentration is different in each case.

Explain how drinking 2 litres of water or alcoholic beer makes urine more dilute and why the concentrations would be different.



The quality of written communication will be assessed in your answer to this question.

[6]

17 Henry has just eaten a chocolate bar.

The table shows the concentration of glucose in the blood entering and leaving some of Henry's organs.

Organ	Concentration of glucose in grams per litre	
	Blood entering the organ	Blood leaving the organ
liver	14	9
pancreas	9	7
small intestine	9	14
stomach	9	6

Glucose concentration **increases** as blood passes through one of the organs.

Write down the name of this organ and explain why glucose concentration increases.

Name of organ

Explanation

.....
.....
.....[3]

18 Kaye is an athlete.

She is resting the day before she runs a long race.

The tables show the water taken in and the water lost by Kaye during the rest day.

	water taken in in cm ³
in food	1000
made by respiration	300
drinking	1200

	water lost in cm ³
in sweat	800
in faeces	100
in urine	

Kaye takes in the same amount of water as she loses.

Work out how much water Kaye loses in urine on the rest day.

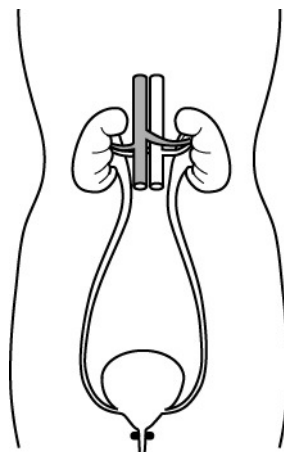
Explain how and why the data in the tables is likely to change on the day of the race.



The quality of written communication will be assessed in your answer to this question.

[6]

19 Kidneys are important organs in excretion.



Write down **one** substance that is normally excreted by the kidneys.

-----[1]



Jessica is an athlete. She has diabetes.

Jessica can help control her blood sugar levels by controlling her diet.

She must **also** inject herself with insulin every day.

Write down which type of diabetes Jessica has.

Explain your answer.

[1]

21 This question is about diabetes.



Jessica is an athlete. She has diabetes.

Jessica can help control her blood sugar levels by controlling her diet.

She must **also** inject herself with insulin every day.

Jessica needs to change the amount of insulin she injects during each day.

Jessica plans a training run immediately after breakfast.

Explain how this changes the amount of insulin she would need to inject.

----- [2]

22 Malaria causes a fever.

The body temperature is very high during a fever and this may cause death.

Describe how high body temperatures can cause death.

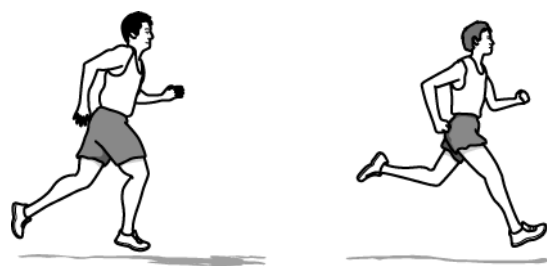
----- [2]

23 The skin is an organ of excretion.

It excretes water from the body in sweat.

Two athletes run in a long race.

They measure their body mass before and after the race.



	Leroy	Sanchez
body mass before race (in kg)	90	64
body mass after race (in kg)	88	60

If a person loses too much water it can make them dehydrated.

The level of dehydration can be worked out using this table.

Percentage change in body mass	Level of dehydration	Symptoms
+1.0 to -1.0	no dehydration	—
-1.1 to -3.0	slightly dehydrated	dry lips, thirsty
-3.1 to -5.0	moderately dehydrated	muscles work less efficiently
-5.1 to -8.0	very dehydrated	muscle spasms and cramps

Leroy works out that his percentage change in body mass was -2.2%.

Work out Sanchez's percentage change.

Use the table to explain which person was most likely to have finished the race.

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Leroy



Sanchez

body mass before race (in kg)

90

64

body mass after race (in kg)

88

60

If a person loses too much water it can make them dehydrated.

The level of dehydration can be worked out using this formula and the table.

$$\text{percentage change in body mass} = \frac{\text{mass after the race} - \text{mass before the race}}{\text{mass before the race}} \times 100$$

Percentage change in body mass	Level of dehydration	Symptoms
+1.0 to –1.0	no dehydration	–
–1.1 to –3.0	slightly dehydrated	dry lips, thirsty
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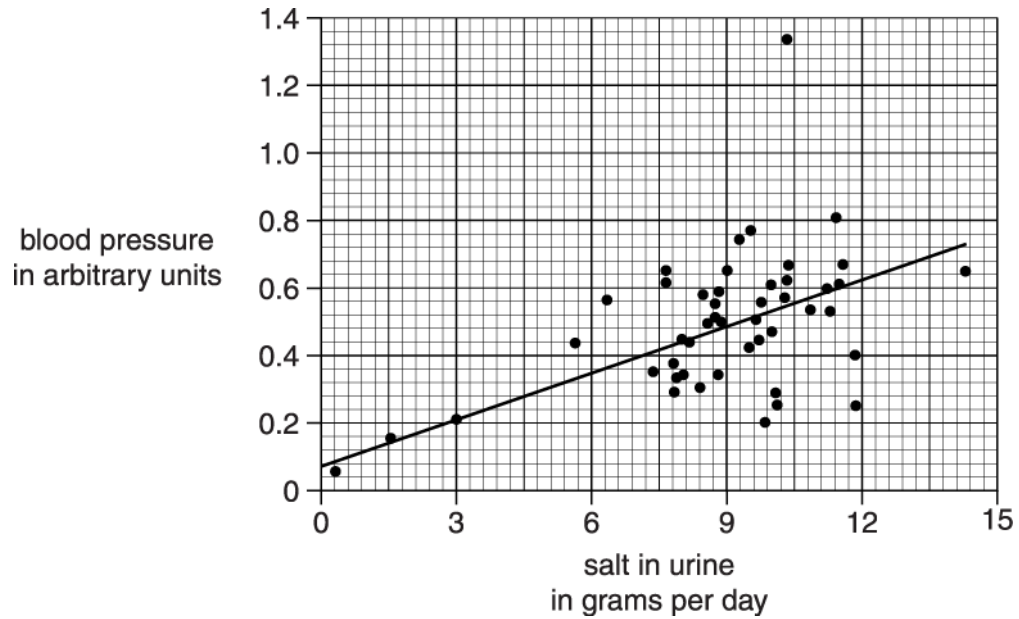
Use the table to explain which person was most likely to have finished the race.

[3]

25 More salt in the diet gives a higher amount of salt in the urine.

Look at the graph.

It shows the relationship between the amount of salt in urine and blood pressure.



Nicola wants to avoid having too much salt in her diet.

Use the information in the graph and your scientific knowledge to explain why.

[2]

26 Some people have a condition which means they do **not** release enough ADH.

Suggest what effects this might have.

----- [2]

27

(i) Cats have fur covering their skin.

The fur reduces heat loss from the skin.

Write down the method of heat loss that fur will reduce.

----- [1]

(ii) Cats lick saliva onto their fur more often in hot weather.

Suggest how this might help them during hot weather.

----- [1]

28 Which of these can be used to treat type 2 diabetes but **not** type 1?

- A Diet and exercise
- B Exercise only
- C Insulin and diet
- D Insulin, diet and exercise

Your answer

[1]

29 Transpiration has a cooling effect on the leaves of plants.

Which statement **best** describes how this happens?

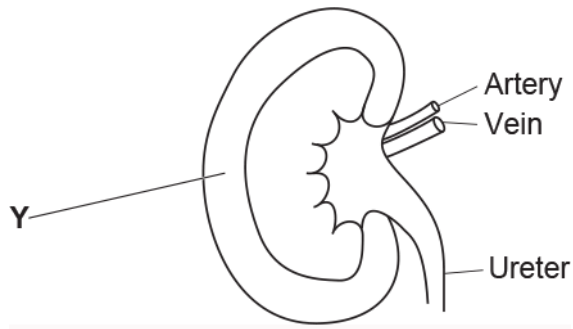
- A Evaporation of water from the leaf removes heat energy.
- B Water entering the stomata takes heat energy from the leaf surface.
- C Water dripping off the leaf causes heat energy to be lost.
- D Water falling on the leaf removes heat energy.

Your answer

[1]

30(a) Look at the diagram.

It shows a vertical section through a kidney.



(i) What is the name of part Y?

-----[1]

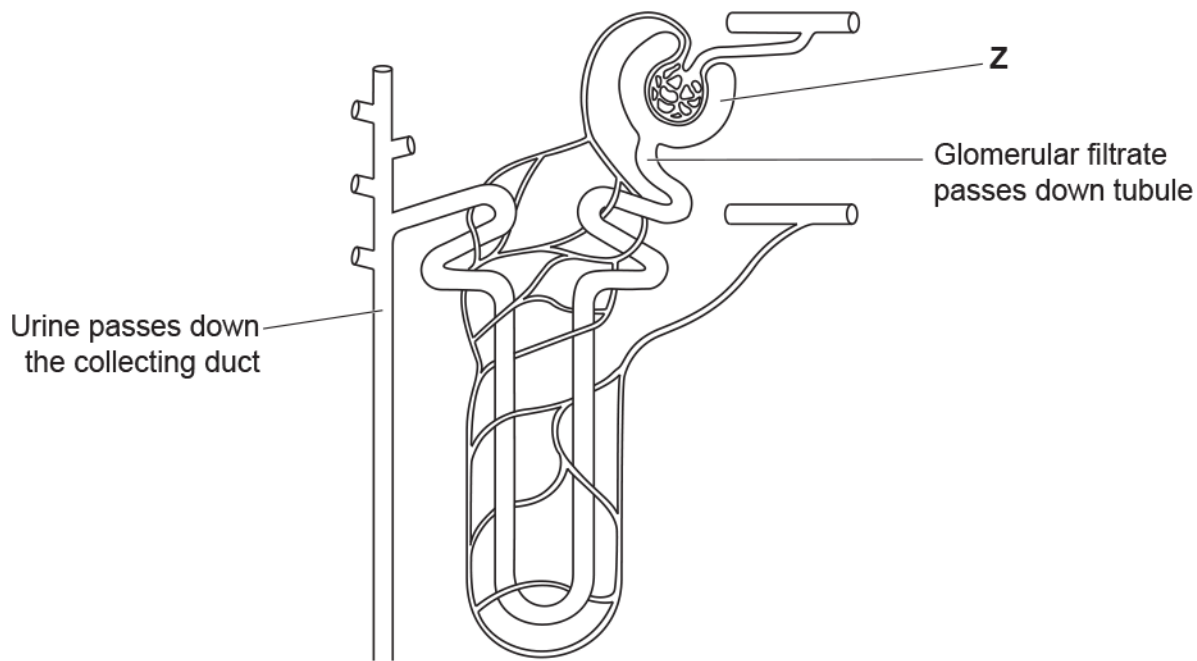
(ii) Which liquid flows through the ureter?

-----[1]

(iii) Draw an arrow in the ureter showing the direction that this liquid flows.

-----[1]

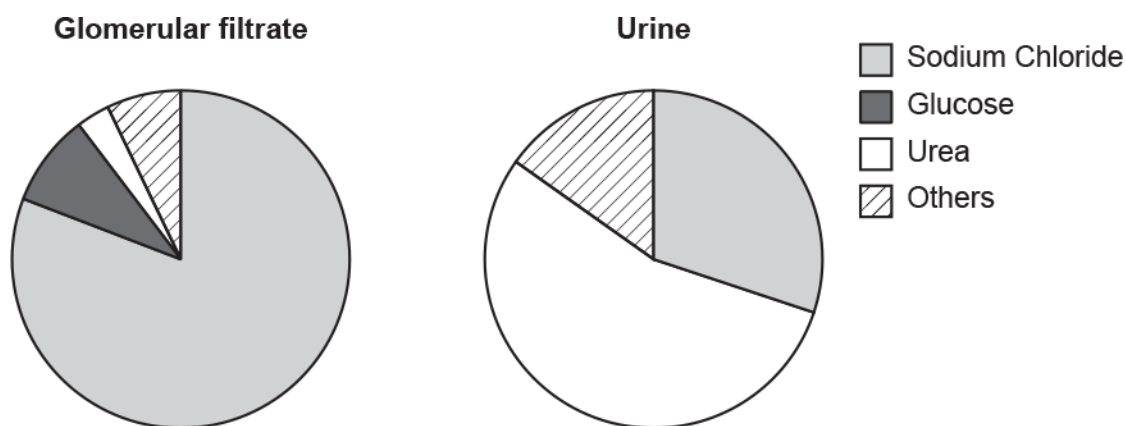
(b) Look at the diagram. It shows a kidney tubule (nephron).



(i) What is the name of part Z?

[1]

(ii) The diagram shows the composition of glomerular filtrate and urine.



What conclusions can be made about what happens between part Z and the collecting duct in the kidney tubule?

Use evidence from the diagram to support your answer.

[3]

(c) The kidney is important for water balance.

The table shows the measurements of water balance for two patients in hospital.

	Volume of water (ml)	
	Patient A	Patient B
Water taken into body in food and drinks	2500	2500
Water made in the body during respiration	200	200
Total input =	2700	2700
Water lost from kidneys in the form of urine	1900	1700
Water lost through skin, lungs and digestive system	1000	1000
Total output =	-----	-----

(i) Calculate the total output for Patient A and Patient B.

Patient A -----

Patient B -----

[1]

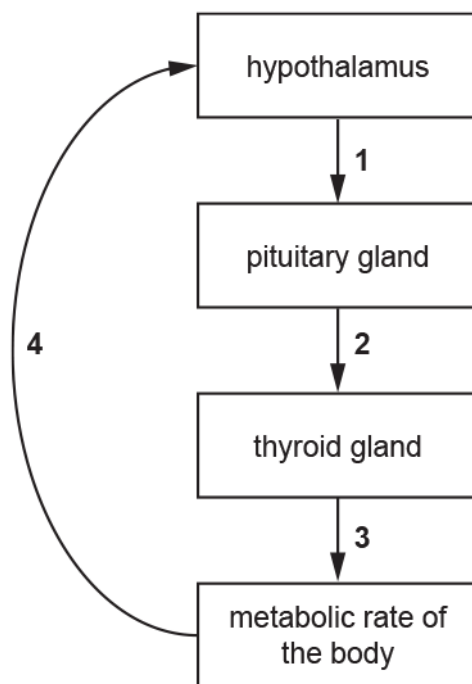
(ii) Which patient needs treatment for their kidneys?

Explain the reasons for your choice.

[2]

31 The level of thyroxine in the body is controlled by negative feedback.

The diagram shows how this takes place.



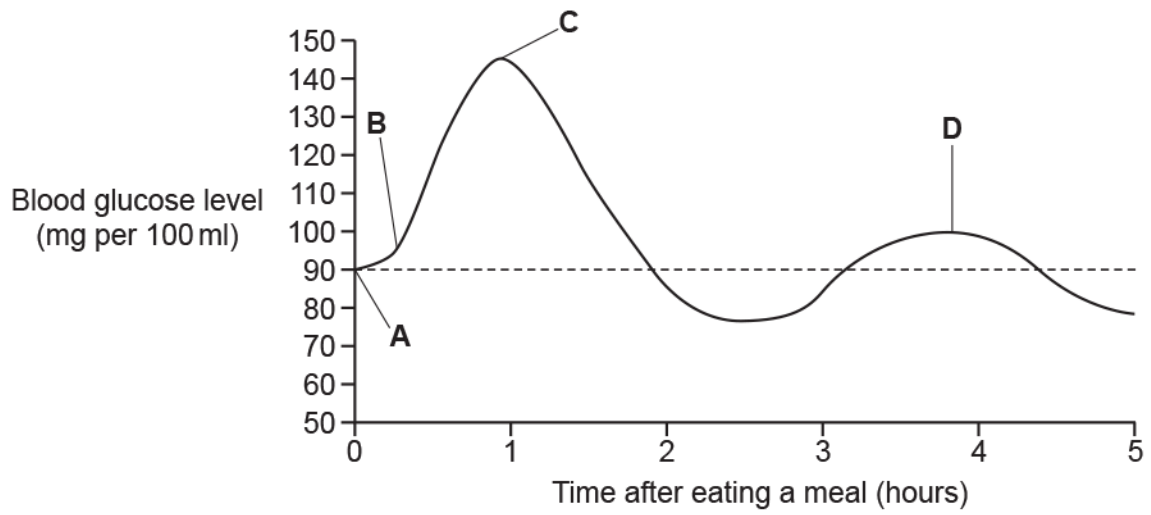
Which numbers on the diagram represent the hormones TSH and thyroxine?

- A 2 = thyroxine 3 = TSH
- B 1 = TSH 3 = thyroxine
- C 3 = TSH 3 = thyroxine
- D 2 = TSH 3 = thyroxine

Your answer

[1]

32 The graph shows blood glucose levels after eating a meal.

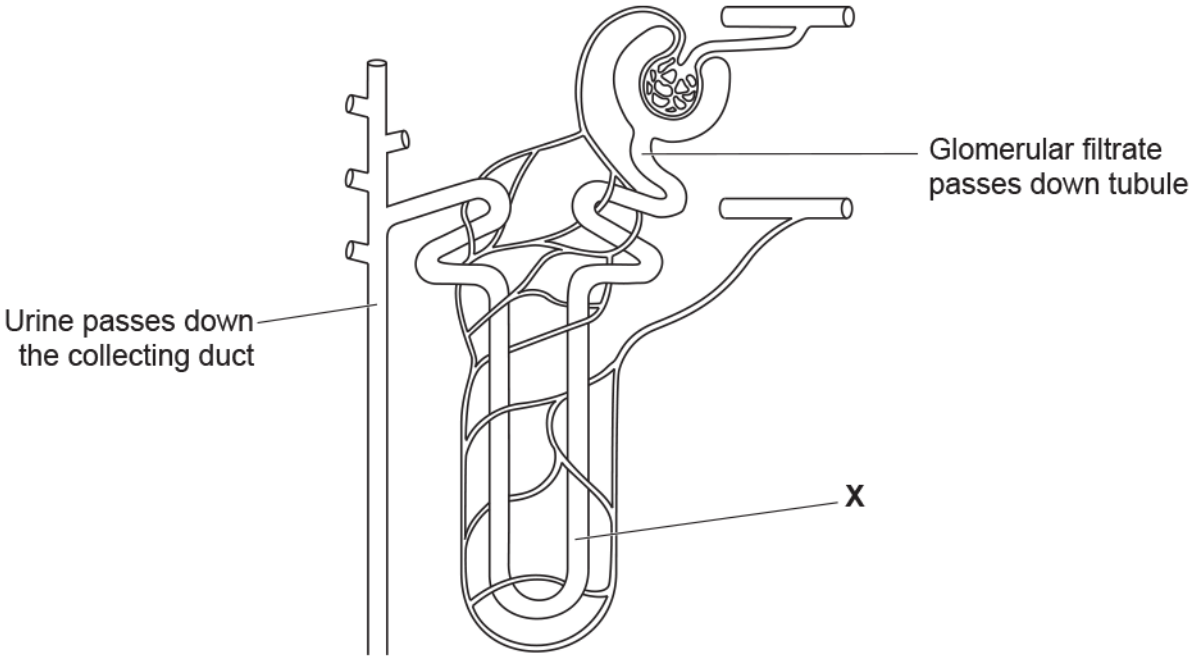


Which point A, B, C or D on the graph would the insulin level in the blood be at its highest level?

Your answer

[1]

33(a) The diagram shows a kidney tubule (nephron).



(i) What is the name of part X?

-----[1]

(ii) The hormone ADH affects the permeability of part of the kidney tubule.

Name the part of the tubule affected by ADH.

-----[1]

(b) * Sports drinks are usually one of three types. Look at the table of information on these types of sports drink.

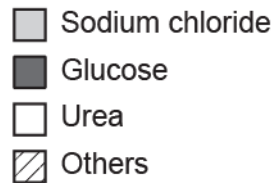
Sports drink	Concentration of solutes relative to body fluids	Mass of carbohydrates (g) (mainly sugars)	Order of how quickly the drink is absorbed
Hypotonic	Less	<4	1
Isotonic	Same	4 – 8	2
Hypertonic	More	>8	3

An athlete is going to run a 10 000 metre race. About an hour before the race the athlete drinks a hypertonic sports drink.

Explain how the race causes changes in water, salt and sugar levels in the athlete's body and explain the athlete's choice and timing of drinks.

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(c) The diagram shows the composition of glomerular filtrate and urine.



What evidence is there to suggest that selective reabsorption occurs in the kidney tubule?

Use evidence from the diagram to support your answer.

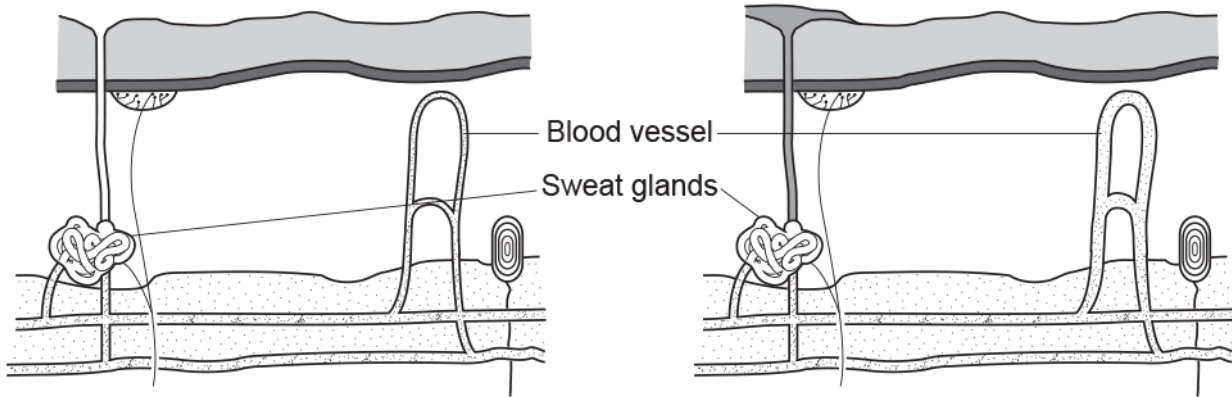
[4]

This question is about control and coordination.

The diagrams show a section through the skin in two different conditions.

Diagram A

Diagram B

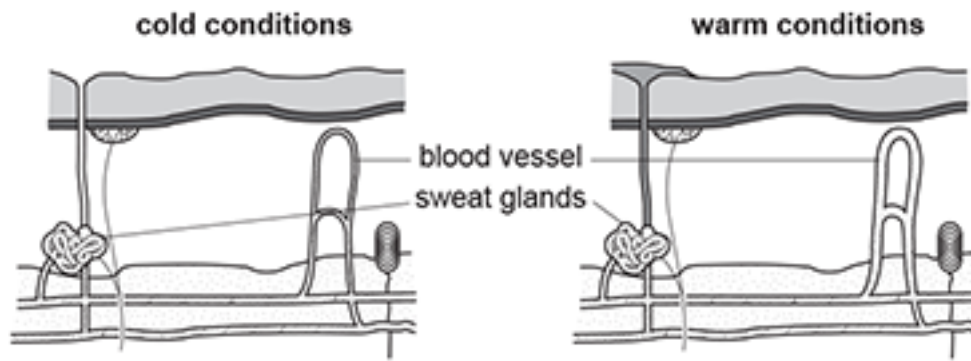


Which diagram shows the skin in a hot, humid environment?

Explain your answer.

[3]

35 The diagrams show changes in the skin as a person moves from cold to warm conditions.



Which processes happen in the skin as a result of the change from cold to warm conditions?

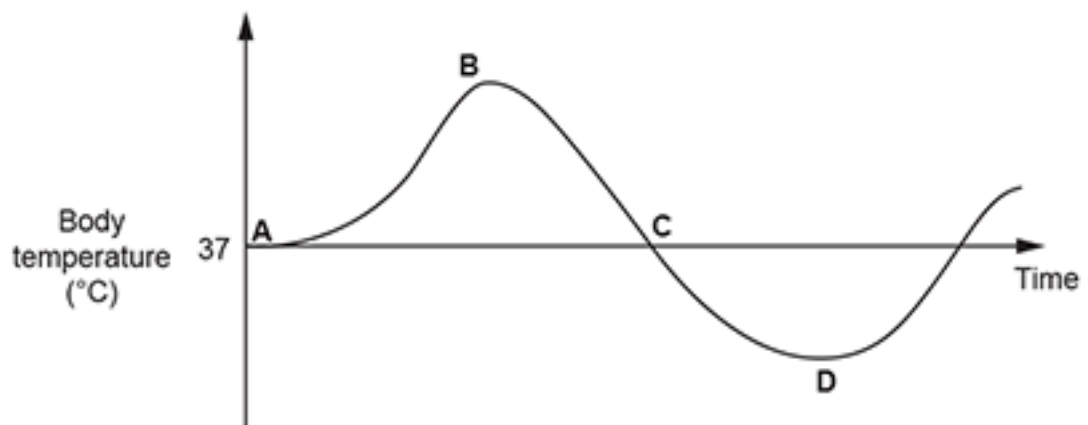
- A Blood vessels widen and sweat is released.
- B Blood vessels narrow and sweat is released.
- C Blood vessels widen and sweat production stops.
- D Blood vessels narrow and sweat production stops.

Your answer

[1]

36 The graph shows changes to body temperature during temperature regulation.

Which letter on the graph shows when shivering is occurring?



Your answer

[1]

- (i) Diabetes occurs when blood sugar levels are not controlled.

Which hormone reduces blood sugar levels?

.....

[1]

- (ii) Hormones are produced in endocrine glands.

Describe how hormones control different parts of the body.

[2]

- (iii) * A glucose tolerance test can help identify if a person has diabetes.

The graphs show a glucose tolerance test in three people A, B, and C.

Key

- - - - Hormone that controls blood sugar levels

—— Glucose

'The Child with a Metabolic Condition', Chapter 31, www.nursekey.com, Nurse Key.

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Link to material: <https://nursekey.com/31-the-child-with-a-metabolic-condition/>

One person is healthy and the other two people have different types of diabetes.

Explain the differences between the three graphs and describe how each person with diabetes could control their blood glucose levels.

Use information from the graphs in your answer.

[6]

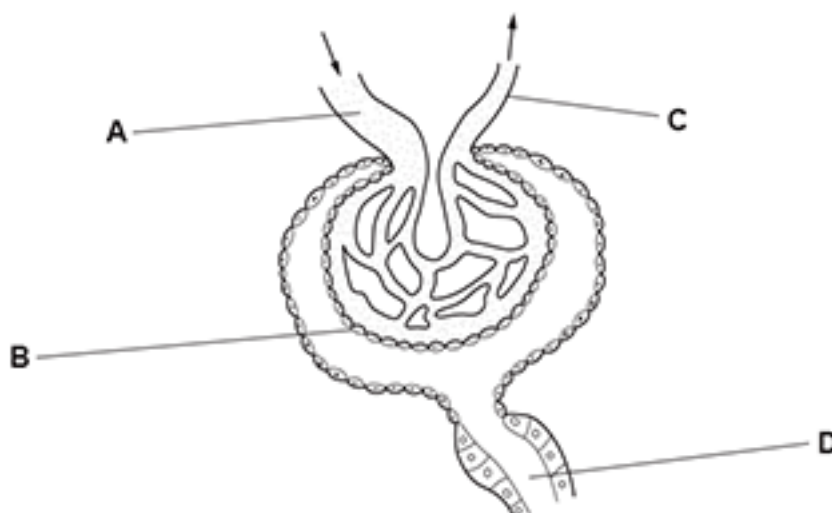
Which organ usually prevents glucose being lost from the blood when urine is made?

[1]

Suggest how a drug can stop an enzyme working.

[2]

38 The diagram shows part of a kidney tubule (nephron).



Which structure is the proximal convoluted tubule?

Your answer

[1]

39 Urine produced after vigorous exercise is often much darker in colour than urine produced when at rest.

Which reason explains why urine becomes darker in colour?

- A Increased sweating and decreased urea production.
- B Decreased ADH production and increased urea production.
- C Increased sweating and increased ADH production.
- D Increased ADH production and decreased urea production.

Your answer

[1]

41(a) Which hormone works with insulin to control blood sugar levels in the body?

Tick (✓) **one** box.

Gibberellin

☐

Glucagon

☐

Glucose

☐

Glycogen

☐

[1]

(b) A glucose tolerance test can help identify diabetes.

The graphs show a glucose tolerance test in three people, A, B and C.

One person is healthy, and two people have different types of diabetes.

Key

—

Glucose

- - - -

Insulin

'The Child with a Metabolic Condition', Chapter 31, www.nursekey.com, Nurse Key.
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(i) Which person has **type 2** diabetes?

Person -----

[1]

(ii) Explain the reasons for your choice in part (i).

[2]

- (c) Scientists are using human embryonic stem cells to grow cells to treat type 1 diabetes.

Explain why scientists use embryonic rather than adult stem cells.

----- [2]

42

- (i) Explain why overheating of the body may stop chemical reactions in cells.

----- [2]

- (ii) * Look at Fig. 20.2 which shows two people riding on boards.

Person A is riding a board on sand in a hot desert. **Person B** is riding a board on snow.

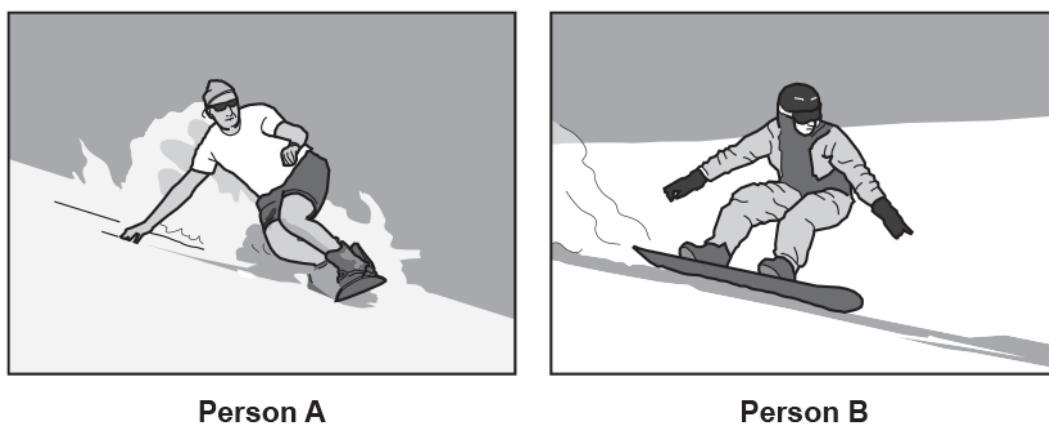


Fig. 20.2

This image shows a blank sheet of white paper designed for handwriting practice. It features ten evenly spaced, horizontal dashed lines that run across the entire width of the page. These lines are intended to guide the placement of letters, typically serving as a baseline or midline for letter height. The paper is otherwise completely empty, with no margins, text, or other markings.

.....

- Explain why lysis happens.

.....

44(a) Fig. 22.1 shows the mass of urea in the urine plotted against the BMI (Body Mass Index) for nine boys. BMI is a value often used to see if a person is a healthy mass for their height.

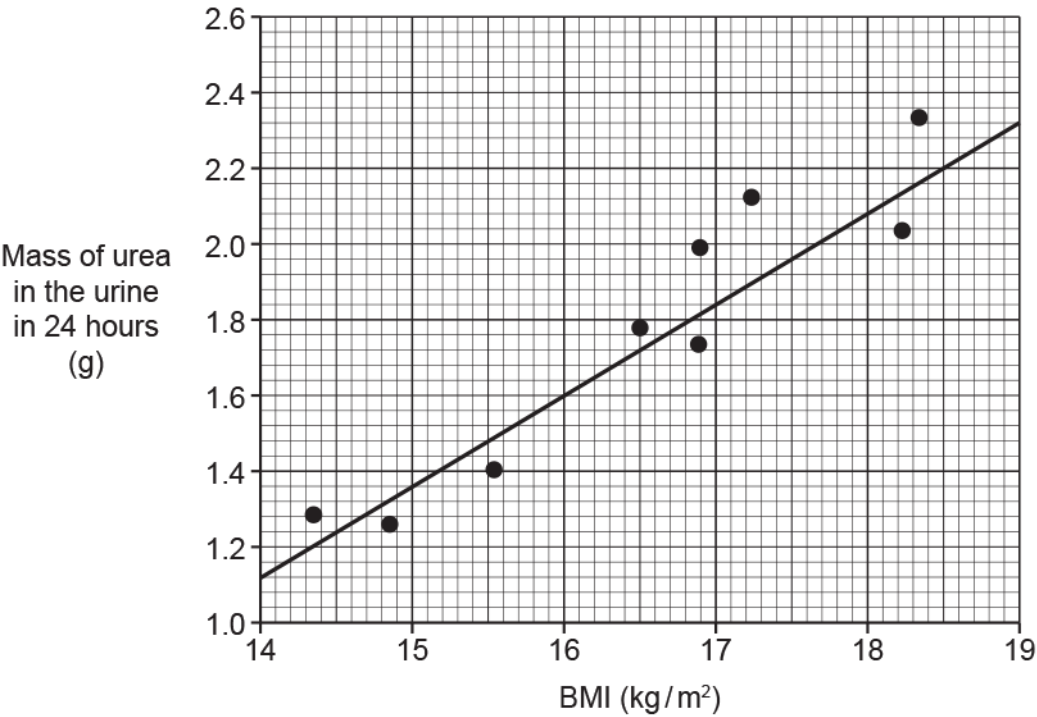


Fig. 22.1

(i) What does the graph show about the relationship between BMI and the mass of urea in the urine?

----- [1]

(ii) A boy has a BMI of 16. He produces 1000 cm³ of urine in 24 hours.

Calculate the concentration of urea in the boy's urine.

Concentration = ...g / cm³
[2]

(iii) Fig. 22.2 shows the mass of urea in the urine against the BMI for nine different boys.

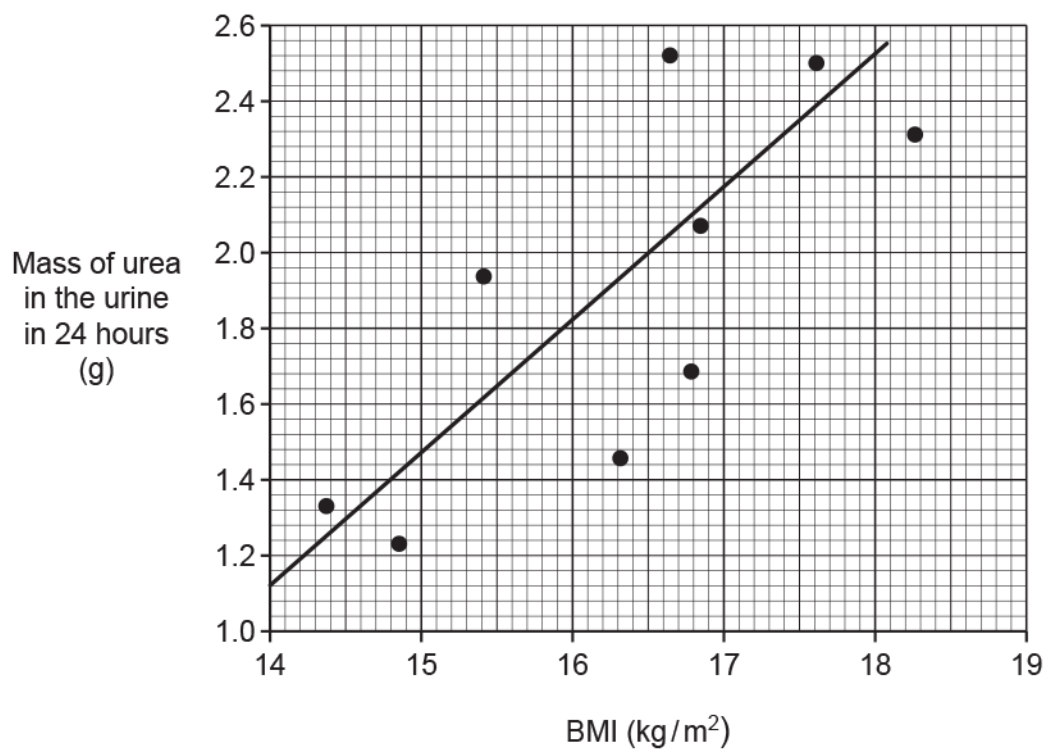


Fig. 22.2

Give **two** differences in the relationship between BMI and the mass of urea in the urine shown in Fig. 22.1 and Fig. 22.2.

- 1 _____

- 2 _____

[2]

- (b) The kidney filters the blood. The fluid produced by filtering the blood passes through kidney tubules.

Each kidney tubule contains a number of different parts.

Put a number (1 to 5) in the boxes to show the order of the parts that the liquid passes through.

The first one has been done for you.

Bowman's capsule	1
Collecting duct	
Proximal convoluted tubule	
Loop of Henlé	
Second coiled region	

[3]

- 45 Zebras (**Fig. 23.1**) have evolved to live in hot grassland in Africa.

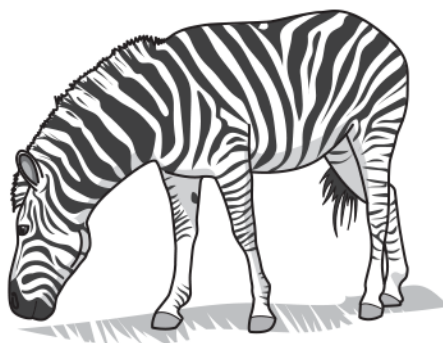


Fig. 23.1

Scientists have tried to find out why zebras have evolved stripes on their body.

One theory is that the stripes help to keep the zebra cooler than other colours. Scientists did an experiment to test this theory. They covered barrels of cold water with the skin of different animals. Then they measured the temperature of the water several hours later.

The results are shown in **Fig. 23.2**.

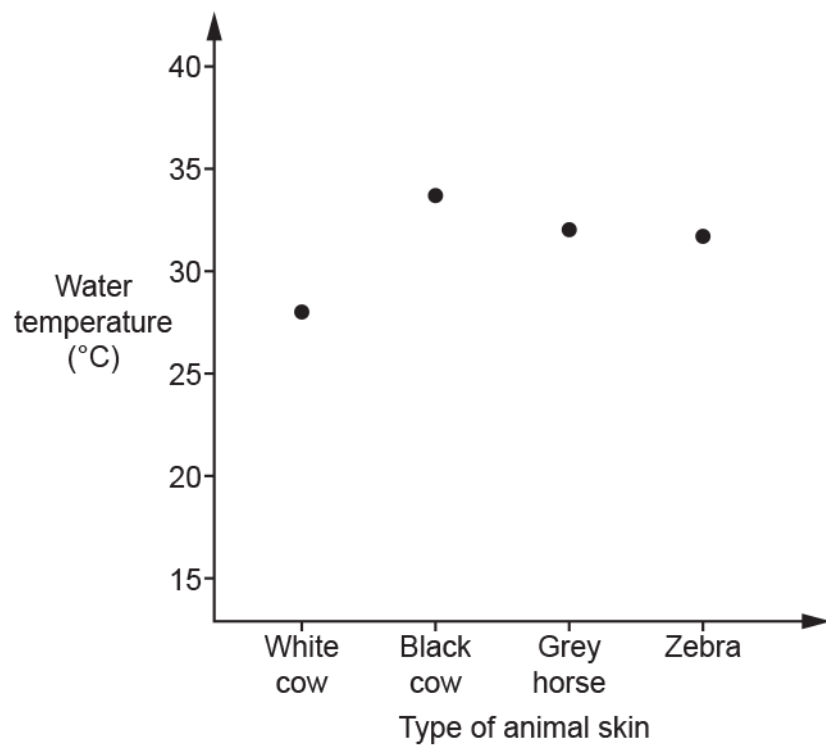


Fig. 23.2

- (i) Do the results in Fig. 23.2 support the theory that stripes keep zebras cool?
Explain your answer.

----- [1]

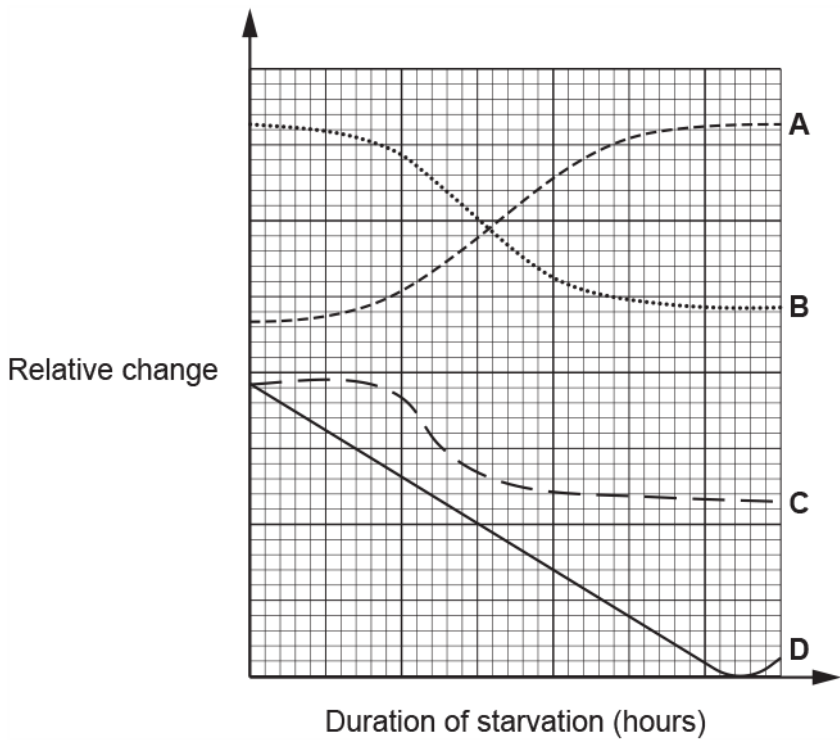
- (ii) The scientists were aiming to investigate if it was **only** the colour of the skin that affected temperature regulation.

Suggest **one** improvement the scientists could make to ensure they **only** investigate the **colour** of the skin.
Explain your answer.

----- [1]

46 Short-term starvation affects the levels of blood glucose, liver glycogen and the hormones insulin and glucagon.

Which line on the graph represents the level of glucagon in the blood during short-term starvation?



Your answer

[1]

47 Red blood cells burst when they are placed in a solution with a much higher water potential than the red blood cells. This is called lysis.

Explain why lysis happens.

[3]

48(a) Fig. 17.1 shows the mass of urea in the urine plotted against the BMI (Body Mass Index) for nine boys. BMI is a value often used to see if a person is a healthy mass for their height.

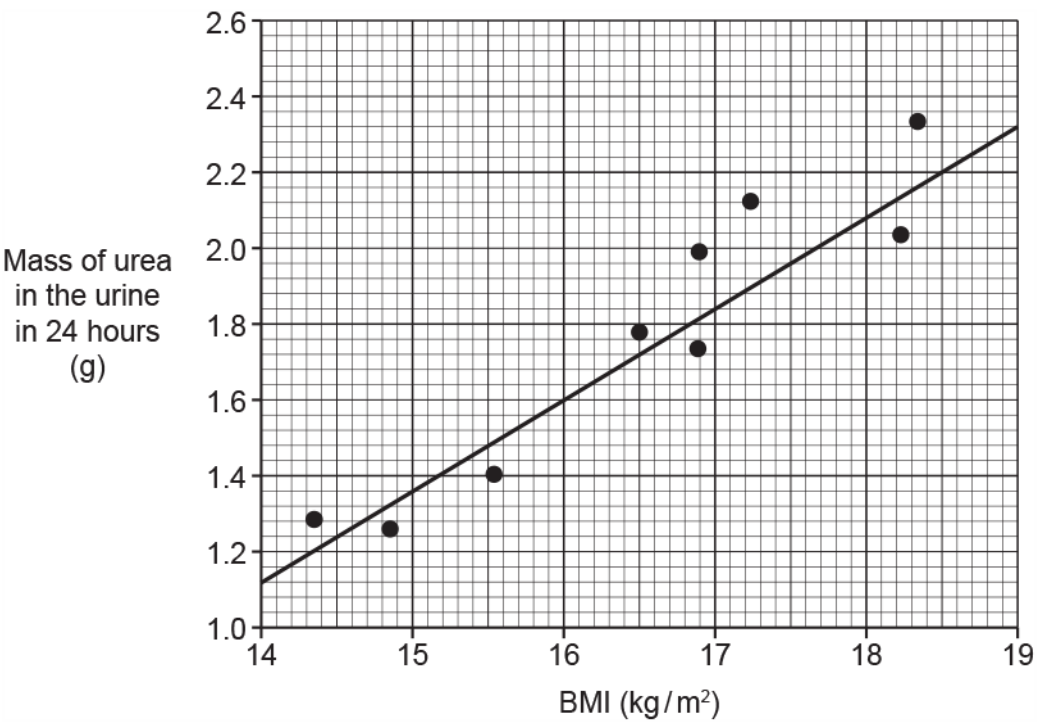


Fig. 17.1

(i) What does the graph show about the relationship between BMI and the mass of urea in the urine?

----- [1]

(ii) A boy has a BMI of 16. He produces 1000 cm³ of urine in 24 hours.

Calculate the concentration of urea in the boy's urine.

Concentration = ... g / cm³ [2]

(iii) Fig. 17.2 shows the mass of urea in the urine against the BMI for nine different boys.

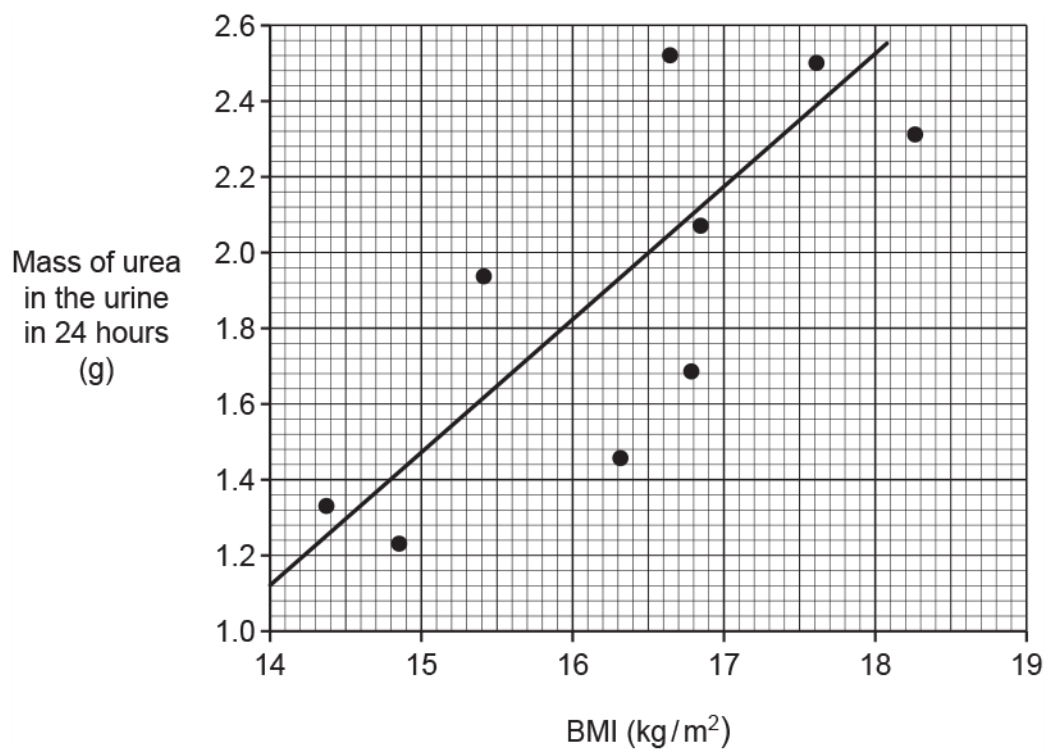


Fig. 17.2

Give **two** differences in the relationship between BMI and the mass of urea in the urine shown in Fig. 17.1 and Fig. 17.2.

1

.....

2

.....

[2]

- (b) The kidney filters the blood. The fluid produced by filtering the blood passes through kidney tubules.

Each kidney tubule contains a number of different parts.

Put a number (1 to 5) in the boxes to show the order of the parts that the liquid passes through.

The first one has been done for you.

Bowman's capsule	1
Collecting duct	
Proximal convoluted tubule	
Loop of Henlé	
Second coiled region	

[3]

- 49 Protein synthesis takes place inside cells.

ADH is a protein hormone made up of amino acids.

- (i) Complete the sentences to explain the link between amino acids and proteins.

Large molecules, like proteins, made of smaller molecules are called

The smaller molecules, or amino acids, are called

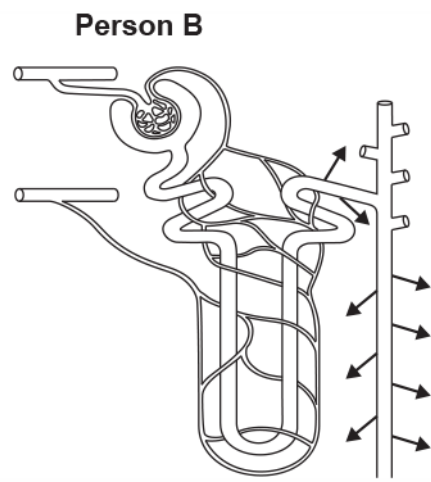
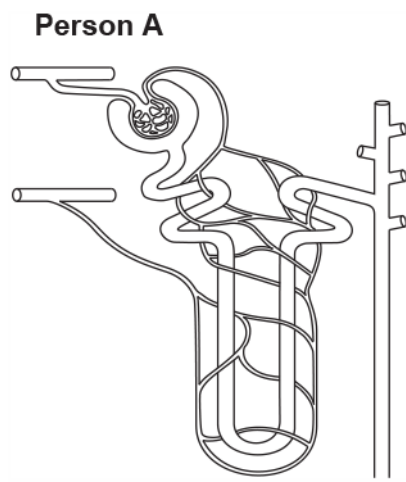
[2]

- (ii) Alcohol inhibits ADH production.

Person **A** and **B** both drank one small 100 ml drink.

Only one of the drinks was high in alcohol.

Look at the diagram of a kidney tubule in person **A** and **B** after the drink.



➡ Movement of water

Explain how you can tell from the diagram that person A's drink contained alcohol.

----- [2]

(iii) After the alcohol has been removed from person A's body, control mechanisms will correct the excess loss of water caused by the alcohol.
Describe these control mechanisms.

----- [2]

50(a) Zebras (Fig. 17.1) have evolved to live in hot grassland in Africa.

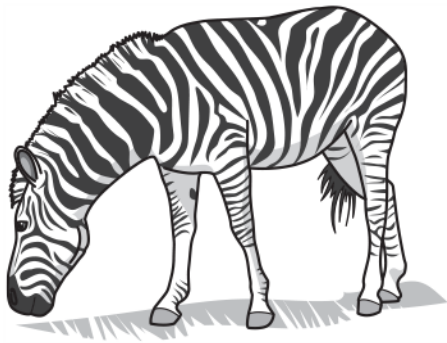


Fig. 17.1

Scientists have tried to find out why zebras have evolved stripes on their body.

One theory is that the stripes help to keep the zebra cooler than other colours. Scientists did an experiment to test this theory. They covered barrels of cold water with the skin of different animals. Then they measured the temperature of the water several hours later.

The results are shown in Fig. 17.2.

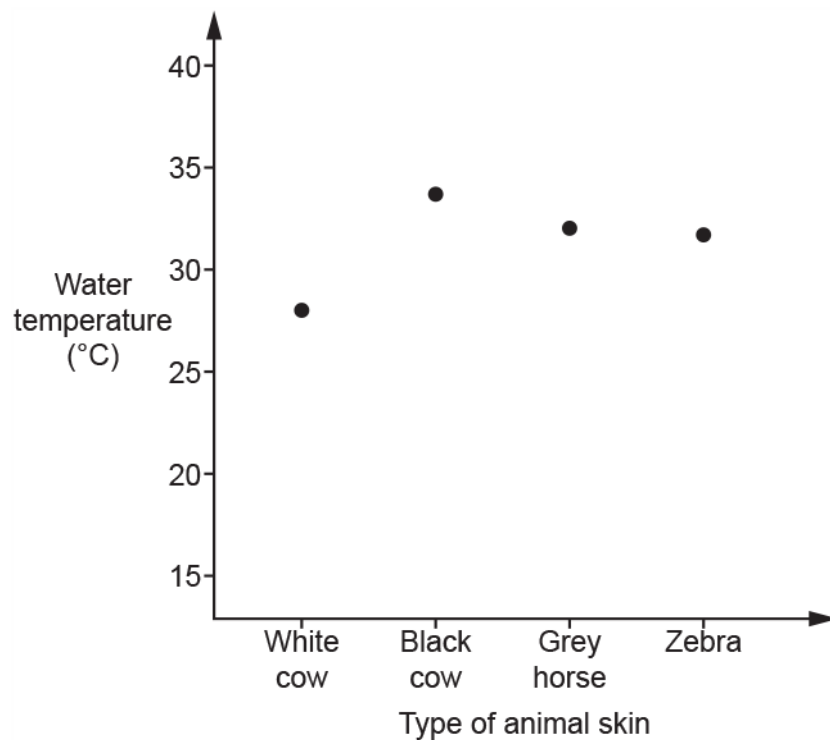


Fig. 17.2

- (i) Do the results in Fig. 17.2 support the theory that stripes keep zebras cool?

Explain your answer.

----- [1]

- (ii) The scientists were aiming to investigate if it was **only** the colour of the skin that affected temperature regulation.

Suggest **one** improvement the scientists could make to ensure they **only** investigate the **colour** of the skin.

Explain your answer.

----- [1]

- (b) Another theory says that the stripes make a zebra less likely to be bitten by insects.

To test this theory scientists made models of zebras and covered them with sticky tape. One model was black. The other models had different widths of stripes.

Fig. 17.3 shows the number of insects that stuck to the tape.

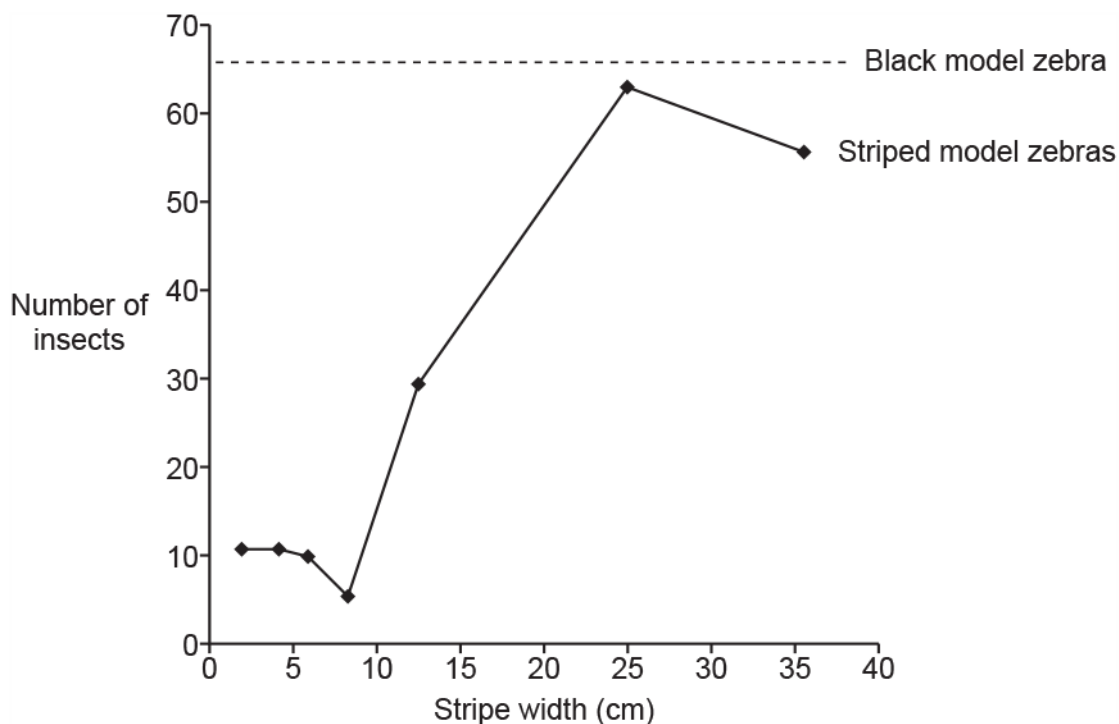


Fig. 17.3

- (i) Describe what Fig. 17.3 shows about the link between zebra stripes and protection from insects.

[2]

- (ii) Horse blankets are used to cover horses when they are outside. Companies have started to produce horse blankets with zebra stripes.

51 A chemical in stevia leaves makes them taste sweet. This chemical is **not** a sugar.
People with diabetes need to know if the food they eat contains sugar.

(i) Describe how you could test some stevia leaves to prove that they do **not** contain sugar.

Reagent used -----

Method -----

Expected result -----

----- [3]

(ii) Will using stevia in foods help people with type 2 diabetes?

Explain your answer.

----- [2]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1			idea that it is a sign of the extent of the disease (1)	1	
			temperatures far away from normal can be dangerous (1)	1	
			Total	2	
2			kidney (1)	1	
			higher volume / less concentrated (1)	1	
			Total	2	
3		i	Tim's and Meena's genotypes Nn (1)	1	
		i	correct genotypes of offspring (NN, Nn, Nn, nn)	1	
		ii	baby may be nn (1)	1	
		ii	one in four chance of baby being affected (1)	1	
		ii	pancreas produces insulin (1)	1	
		ii	insulin controls blood glucose level (1)	1	
			Total	6	
4			C	1	
			Total	1	
5			A	1	
			Total	1	
6			B	1	
			Total	1	
7		i	Tim's and Lucy's genotypes Nn (1)	1	allow correctly completed punnet square
		i	correct genotypes of offspring (NN, Nn, Nn, nn) (1)	1	
		ii	baby may be nn (1)	1	
		ii	one in four chance of baby being affected (1)	1	
		ii	pancreas produces insulin (1)	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	insulin controls blood glucose level (1)	1	
			Total	6	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
8	[Level 3] Explains implications of all three conditions, at least one of them in detail and at least one calculation that indicates the number of people that may be involved. Quality of written communication does not impede communication of the science at this level. (5–6 marks) [Level 2] Explains implications of two conditions and at least one calculation that indicates the number or a calculated percentage of people that may be involved or two conditions at least one of them in detail. Quality of written communication partly impedes communication of the science at this level. (3–4 marks) [Level 1] Explains implications of at least one condition. Quality of written communication impedes communication of the science at this level. (1–2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A. Indicative scientific points at level 3 may include: • plaque formation / fatty deposits in the coronary arteries can lead to reduced blood supply to heart muscle / lack of oxygen and or glucose to heart muscle / thrombosis • high blood pressure is linked to (an increased risk of) thrombosis / strokes / kidney damage • allow Type 2 diabetes causes kidney damage / blindness / poor circulation / ulcers Indicative scientific points at level 1, 2 may include: • too much cholesterol in the blood can form plaques in the walls of arteries ignore high blood cholesterol is linked to (an increased risk of) heart disease (low demand) • failure to respond to insulin is failure to control blood sugar levels / Type 2 diabetes • ignore failure to respond to insulin is diabetes (low demand) Indicative scientific points at level 1 only: • high blood pressure is linked to (an increased risk of) heart disease / heart attack • allow 1 mark for correct calculation only with no other explanations example of calculations • 30 000 people in Singapore have all three conditions (or similar calculation) • 330 000 have high blood pressure only • 68% have a single condition • 60% have at least one heart related / circulatory disease Use L1, L2, L3 annotations in scoris; do

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					not use ticks. Examiner's Comments There were some good descriptions of the effects of cholesterol and high blood pressure. A number of candidates simply repeated the data given in the pie chart without any type of numerical calculations. The distinction between type 1 and 2 diabetes was often confused and this often limited access to the higher marks.
			Total	6	
9			sweat evaporates (1) taking heat from the skin (1)	2	allow heat is lost from the body allow takes heat from the body ignore cools body down as in stem of question Examiner's Comments Most knew that it was the evaporation of sweat which caused the cooling effect. Other candidates did not mention that the evaporation of sweat needed heat from the body. A few candidates' responses suggested that the sweat, itself, cools the skin.
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
10		i	brain / hypothalamus (1) (monitors) temperature of blood (1)	2	ignore body temperature (in question) Examiner's Comments Often candidates got the 'brain' mark but did not score on the idea of it monitoring the blood. Many responses just referred to body temperature.
		ii	any two from: (more) blood flows close to surface (1) (increased) heat loss (1) by radiation / conduction / convection (1)	2	not blood vessels move closer to surface allow any heat transfer but needs to be a loss from the body Examiner's Comments The most common reason why candidates did not score on the first marking point was because they described blood vessels as 'moving closer to the surface', this often negating earlier references to widening blood vessels. A number of the candidates who did not understand the process did gain a mark for the idea that heat was lost, although they often incorrectly linked it to sweating.
			Total	4	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
11			heat stroke (1) dehydration (1)	2	ignore just 'stroke' allow hyperthermia allow insufficient water to remove toxins allow higher level answers e.g. damage to enzymes / stops enzymes working / denatures enzymes (1) allow preventing chemical reactions happening (1) ignore kills enzymes ignore burn or body becomes too hot or overheats ignore damage to any body part e.g. organ failure Examiner's Comments Half the candidates gained at least one mark, though few gained two. The mark was most commonly awarded for the idea that high body temperatures may cause death through dehydration, although a few did correctly explain the effect on enzymes. No credit was given for vague answers such as 'organ failure'.
			Total	2	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
12	Level 3 (5-6 marks) Answer includes reference to heart disease AND diabetes. The link between type 2 diabetes and failure to respond to insulin AND between high blood pressure / cholesterol and heart disease is made. At least one calculation indicates the number of people that might be involved. Quality of written communication does not impede communication of the science at this level. Level 2 (3-4 marks) Answer includes reference to heart disease OR diabetes. There is some attempt to link diabetes with failure to respond to insulin OR to link heart disease with high blood pressure / cholesterol Quality of written communication partly impedes communication of the science at this level. Level 1 (1-2 marks) Answer includes some reference to heart disease OR diabetes. Quality of written communication impedes communication of the science at this level. Level 0 (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.	6	This question is targeted at grades up to C Relevant points include: • high blood pressure is linked to an increase risk of heart disease • high blood cholesterol is linked to an increase risk of heart disease • failure to respond to insulin indicates type2 diabetes • too much cholesterol in the blood can form plaques in the walls or arteries • 30 000 people in Singapore have all three conditions (or similar calculation). allow higher level answers involving blood pressure and strokes / kidney damage and the consequences of plaque formation in the coronary arteries Level 3 - full answer but no/wrong calculation then max 5 marks allow level 1 (2 marks max) for correct calculation with no reference to heart disease/diabetes if refer only to heart attacks instead of heart disease then allow 1 mark (level 1) or 3 marks (level 2) Use L 1, L2, L3 annotations in scoris. Do not use ticks. Examiner's Comments This 6 mark extended answer question was targeted across low and standard demand. Accordingly, although two thirds of candidates gained some credit, very few went beyond 4, the most common mark. The question asked candidates to not only use the data provided but also their own biological knowledge and also to include calculations. Some candidates wrote at great length but only described what the pie chart showed, without adding anything

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					extra, and were not awarded any marks. To gain level 1 (1 or 2 marks) candidates had to appreciate that the conditions could lead to heart disease or diabetes. For level 2 (3 or 4 marks) they had to correctly link heart disease or diabetes to the specific conditions tested for. To gain level 3 (5 or 6 marks), candidates should have stated that failure to respond to insulin is linked specifically to type 2 diabetes, as well as include at least one calculation using the data given, eg to state that 30 000 people had all three conditions. Very few attempted any calculations.
			Total	6	
13			to lose heat/ keep cool (1)	1	allow for temperature regulation Examiner's Comments Three quarters of candidates knew that sweating helps to lose heat or to cool the body down. No credit was given for the idea that it is a way of losing water.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
14		i	A = ureter (1) B = cortex (1)	2	allow phonetic spelling not urethra Examiner's Comments A third of candidates could name the ureter or cortex in the cross section of a kidney, and half of these could name both. Common errors were to name the cortex as the medulla, and the ureter as the urethra. Although misspelt words are usually credited if they are phonetically correct, if an answer was somewhere in between ureter and urethra, and could have been either, it was not given the mark.
		ii	to filter (the blood) (1)	1	allow molecules / substances are forced out (of blood) allow ultrafiltration ignore just remove waste Examiner's Comments Over a third of candidates correctly explained that the high blood pressure in the kidney is needed to filter the blood. It was not enough to simply say so that the kidney could work.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
15	a		percentage working decreases over time / ORA (1) less points / A grade will have a greater chance of still a working / lasting longer / ORA (1)	2	ignore just negative correlation allow correct comparison e.g. A and B last longer than C and D allow converse answers ignore actual data on its own Examiner's Comments There were two patterns to be described in the graph, but despite there being two marks many candidates only described one pattern. Candidates need to be as clear as possible in their answers. For example, a mark was gained for saying that the lower the point score, the longer a kidney would last. However a mark was not awarded if candidates referred to a lower grade, as it is not clear which letter is 'lower'. When asked to describe a pattern in a graph, candidates should include the variables in their answer and not say something like 'the lines go down'. Most candidates gained one mark, and a quarter gained two.
	b		7% (difference) (2) BUT Manjit grade B/79% and Georgina grade C/72% (1)	2	allow answers written by table Examiner's Comments Over half the candidates gained at least one mark by working out the percentage chance for each person, but only a third worked out the difference between these as being 7%. Although some incorrectly calculated the difference, there were many who did not attempt to work out the difference at all.
			Total	4	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance																		
16	a		<table><tr><th>part of the kidney</th><th>letter</th><th></th></tr><tr><td>cortex</td><td>E</td><td></td></tr><tr><td>medulla</td><td>D</td><td></td></tr><tr><td>renal artery</td><td>(A)</td><td></td></tr><tr><td>renal vein</td><td>B</td><td></td></tr><tr><td>ureter</td><td>C</td><td>(2)</td></tr></table>	part of the kidney	letter		cortex	E		medulla	D		renal artery	(A)		renal vein	B		ureter	C	(2)	2	3 or 4 correct (2) 1 or 2 correct (1) Examiner's Comments Almost all candidates gained at least 1 mark for correctly identifying the parts of a kidney. The most common error was to confuse the cortex and medulla.
part of the kidney	letter																						
cortex	E																						
medulla	D																						
renal artery	(A)																						
renal vein	B																						
ureter	C	(2)																					
	b		(Level 3) Explains the role of ADH in controlling the amount of water removed in urine and how alcohol affects the action of ADH. Quality of written communication does not impede communication of the science at this level. (5–6 marks) (Level2) Explains the role of ADH in controlling the amount of water removed in urine. Quality of written communication partly impedes communication of the science at this level. (3–4 marks) (Level 1) Gives a simple description that the kidneys remove excess water. Quality of written communication impedes communication of the science at this level. (1–2 marks) (Level 0) Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A* Indicative scientific points at level 3 includes level 2 points plus - explains that alcohol causes even more water to be lost / even less reabsorbed. ignore alcohol reduces ADH (in question) Indicative scientific points at level 2 may include: - ADH increases the amount of water reabsorbed / reduces amount lost in urine - less ADH decreases the amount of water reabsorbed / increases amount lost in urine - ADH increases permeability of kidney tubules so more water is reabsorbed back into the blood - increased water in blood reduces the amount of ADH Indicative scientific points at level 1 may include: - kidneys remove excess water (to form dilute urine) - kidneys reabsorb less water. ignore drinking more water / beer increases volume of urine ignore drinking more water / beer makes																		

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					urine more dilute (in question) allow level 1, 2 marks max for drinking alcohol causing more dilute urine than drinking water (no mention of ADH) Use L 1, L2, L3 annotations in scoris. Do not use ticks. Examiner's Comments This was a challenging question with a very small minority gaining all 6 marks. No credit was given for repeating the statements given in the question that alcohol reduces ADH release, and that drinking either beer or water will make urine more dilute. Many candidates' answers were little more than these statements reworded. To gain credit, candidates had to give some explanation of the role of ADH, as well as explain why urine was more dilute after drinking beer than after drinking the same amount of water. Many candidates thought that drinking 2 litres of alcohol would lead to more concentrated urine than drinking 2 litres of water, explaining this as being because alcohol is more concentrated than water.
			Total	8	
17			small intestine (1) food has been digested by this point / is digested here (1) glucose from food is absorbed here / passes through the lining of small intestine (1)	3	Examiner's Comments Many candidates correctly identified the small intestine but few could correctly explain the increase, many just referring to the concentration of glucose in the intestine.
			Total	3	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
18	[Level 3] Answer correctly calculates urine volume during the day before race. It also predicts one reason why one output may change during the race with a reason and link this to one change in input. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Answer correctly calculates urine volume during the day before race. It also predicts one change that may occur on the day of the race. OR Answer predicts one reason why one output may change during the race with a reason and link this to one change in input. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Answer correctly calculates urine volume during the day before race or predicts one change that may occur on the day of the race. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at G to C Indicative scientific points may include: during day before race: • At rest Kaye is taking in 2500cm^3 • Therefore she must give out 2500cm^3 • Her urine volume must be 1600cm^3 during day of race: • during race she will sweat more / sweating will help to lose heat generated in race linked to: water will need to be replaced so likely to drink more or • during race she will sweat more / sweating will help to lose heat generated in race linked to: likely to pass less urine Other predictions include: • Respiration rate will increase during race • More water gain from respiration Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments Many candidates could correctly calculate the volume of urine lost. They could also make a prediction for changes on the day of the race such as an increase in sweating. Only the better answers included

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					a linked explanation for changes on the day of the race.
			Total	6	
19			urea / water / salts (1)	1	ignore urine Examiner's Comments By far the most common error here was to confuse urea with urine.
			Total	1	
20			Type 1 and a correct reason Type 1 is insulin dependent / early onset / juvenile (1) Type 1 doesn't produce any / enough insulin (1) Type 2 can be controlled with diet only (1)	1	Type 2 / Type A / Type B = 0 allow Type 1 has to be controlled by injecting insulin / she needs insulin ignore she injects insulin (in the stem of the question) / she uses insulin allow pancreas doesn't work allow Type 2 is late onset / associated with obesity Jessica is neither / Type 2 not insulin dependent Examiner's Comments Candidates who correctly identified the type of diabetes usually went on to give the correct reason. There were a few that just repeated the stem of the question and were not credited.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
21			insulin dose would be less / decreases (1) because she would use up blood sugar / glucose (1)	2	ignore sugar / glucose unless clearly linked to blood Examiner's Comments Most marks were gained from the 'less needed' marking point. Many candidates failed to gain credit because they did not say sugar in blood decreases.
			Total	2	
22			heat stroke (1) dehydration (1)	2	ignore just 'stroke' allow hyperthermia allow insufficient water to remove toxins allow higher level answers e.g. damage to enzymes / stops enzymes working / denatures enzymes (1) allow preventing chemical reactions happening (1) ignore kills enzymes ignore burn or body becomes too hot or overheats ignore damage to any body part e.g. organ failure Examiner's Comments Most candidates mentioned enzymes denaturing, but didn't put the relatively simpler answers of heat stroke and dehydration. Many high level answers explained enzymes' function.
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
23			(calculation for Sanchez) (-) 6.3 (%) (1) Sanchez is very dehydrated and will have muscle spasms / cramps (1)	2	second marking is dependent on the first allow: (-) 6.25 (%) / (-) 6 (%) (1) allow: ecf for symptoms if calculation incorrect e.g. calculate (-) 4.2 then say moderately dehydrated and his muscles work less efficiently (1) ignore choice of who wins Examiner's Comments Many candidates found the percentage change calculation difficult one common error was to divide the difference by the mass after the race rather than at the start. Those that correctly calculated the percentage change often lost the second mark by not providing a full explanation as to why Sanchez was unlikely to win the race.
			Total	2	
24			(calculation for Sanchez) (-) 6.3 (%) (1) Sanchez is very dehydrated and Leroy is slightly dehydrated (1) Sanchez (less likely to complete the race as he) will have muscle spasms / cramps (1)	2	allow: (-) 6.25 (%) / (-) 6 (%) (1) allow: ecf for symptoms if calculation incorrect ignore choice of who wins Examiner's Comments Many candidates could correctly calculate the percentage for Sanchez and link it to the information in the table.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
25			increased salt (in diet) leads to higher blood pressure (1) high blood pressure leads to increased risk of developing heart disease / risk of stroke / blood vessels bursting (1)	2	allow positive correlation between salt in diet and blood pressure ignore high salt in urine causes high blood pressure Examiner's Comments The main issue for some candidates was the failure to differentiate between salt in the diet leading to higher blood pressure and the salt in the urine being an indicator of salt in the diet.
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
26			any two from: too much / more urine is released (1) urine is more dilute (1) blood is too / more concentrated (1) increased thirst (1) less water reabsorbed (into blood) (1)	2	must be comparative allow urinate more often allow urine has a higher concentration of water allow blood has a lower concentration of water allow become dehydrated / need to drink more water ignore references to permeability of tubules (as in question) Examiner's Comments A minority of candidates gained marks in this question. No credit was given for simply taking the information from the table in part (i) and saying that a lack of ADH would decrease the permeability of kidney tubules, rather candidates had to describe the consequences of this. Commonly seen correct answers were that less water would be reabsorbed, more urine would be produced, urine would be more dilute, and that people would become dehydrated. Some candidates gave the reverse of these ideas; others gave contradictory answers such as less water reabsorption would make urine more concentrated.
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
27		i	sweating (1)	1	allow evaporation / conduction / convection / radiation Examiner's Comments Many candidates misread the question and wrote about insulation, although a large minority did correctly explain that fur reduces sweating. Quite a few candidates left this blank.
		ii	cools them down / removes heat / so they do not overheat / saliva acts like sweat (1)	1	allow higher level responses referring to saliva evaporates Examiner's Comments Most candidates correctly explained that the saliva would cool cats down.
			Total	2	
28			A ✓	1 (AO 1.1)	Examiner's Comments Although some candidates identified diet and exercise, most candidates chose an option that included insulin. Candidates need to be careful to take note of emboldened words in the question.
			Total	1	
29			A ✓	1 (AO 1.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
30	a	i	cortex✓	1 (AO 1.1)	<u>Examiner's Comments</u> The question assessed recall AO1.1 for structure of the kidney. Few candidates could identify the cortex, although some did mix it up with the medulla. Most referred to just the kidney or membrane. Many candidates put no answer.
		ii	urine✓	1 (AO 1.1)	<u>Examiner's Comments</u> This tested recall, AO1.1, of the function of the ureter. Some candidates were able to identify urine as the liquid flowing through the ureter. However, common incorrect responses were water, blood and urea.
		iii	arrow on diagram points downwards from kidney in same line as ureter✓	1 (AO 2.1)	ALLOW arrow pointing downwards even if not on ureter <u>Examiner's Comments</u> Candidates could apply their knowledge of direction of flow of urine. The flow in the ureter was well understood by most candidates. There were some candidates however, that had the flow back into, and in some cases, around the kidney.
	b	i	Bowman's capsule✓	1 (AO 1.1)	<u>Examiner's Comments</u> The majority of candidates found this recall AO1.1 question very challenging.. A small number of candidates correctly identified the Bowman's capsule. Some candidates put glomerulus, presumably using one of the labels as a memory prompt, but many no responses were seen.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	glucose present in filtrate but not in urine / more sodium chloride in filtrate than urine / urea/others levels much higher in urine ✓ glucose/sodium chloride must be reabsorbed✓ urea/others excreted in urine✓	3 (AO 2.2) (AO 2 x 3.2b)	ALLOW urea/others removed from body <u>Examiner's Comments</u> This question assessed both AO2 and AO3 assessment objectives. This is key to how successful candidates were in their response. Candidates often limited themselves to only one mark due to just stating what happened to the different substances in the filtrate or collecting duct as evidenced in the pie charts. The question required candidates to make conclusions based on the evidence and only a few higher ability candidates linked these changes to reabsorption and excretion.  This highlights a lack of awareness in candidates for what is required from a question asking them to draw conclusions from data. Many just described the data.
	c	i	Patient A = 2900 & Patient B = 2700 ✓	1 (AO 2.2)	Mark answer line first but if nothing on answer line check table for correct answer <u>Examiner's Comments</u> Mathematical skills were assessed in this question. Most candidates got the correct calculations. Occasionally the correct calculations were seen in the table but then candidates wrote 900 and 700 on the answer line and did not gain the mark.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	(Patient A) total output of patient A is 2900/exceeds total input / patient B input matches output✓ patient A is losing too much water (from the kidneys)✓	2 (AO 2.1) (AO 3.2a)	No marks if Patient B identified ALLOW input output is imbalanced in patient A ALLOW patient A loses more water than normal <u>Examiner's Comments</u> The question required analysis and evaluation to provide a successful response. Most candidates selected Patient A and many then went on to gain at least 1 mark. This was usually for input less than output. Some also then explained that this would lead to water imbalance. Occasionally, candidates would not gain marks even though they had selected the correct patient because they compared the water output to Patient B. Exemplar 2 <i>They are losing more water in the form of urine than patient B. because Patient A total output is 2900 whereas Patient B total output is 2700. [2]</i> In this case the candidate implies that they have decided Patient A needs treatment but haven't said it specifically. This would not prevent the candidate gaining marks but their explanation is comparing water output to Patient B which is incorrect. The correct explanation needs candidates to compare the input and output for each patient separately. This highlights the need for candidates to gain a greater understanding that homeostasis is about maintenance of an individual's internal environment and data should be considered within that same individual and not across others as well.
			Total	10	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
31			D ✓	1 (AO 2.1)	
			Total	1	
32			C ✓	1 (AO 2.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
33	a	i	loop of Henlé✓	1 (AO 1.1)	Examiner's Comments The name of this part of the tubule was correctly recalled by many of the higher ability candidates.
		ii	collecting duct✓	1 (AO 1.1)	ALLOW DCT IGNORE collection duct Examiner's Comments Fewer candidates could answer correctly in part ii), often stating the glomerulus as their answer.
	b		Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Explains more than one body response to different temperature <u>and</u> osmotic challenges. AND applies knowledge and understanding to identify a drink requirement both pre-race <u>and</u> post-race AND analyses information and ideas to explain which sports drink is best for pre-race <u>and</u> for post-race. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Explains a body response to different temperature <u>or</u> to osmotic challenges AND applies knowledge and understanding to identify a drink requirement for pre-race <u>or</u> for post-race. AND analyses information and ideas to explain which sports drink is best for pre-race <u>or</u> for post-race.	6 (AO 2 × 1.1) (AO 2 × 2.1) (AO 2 × 3.2a)	AO1.1 Demonstrate knowledge and understanding of scientific ideas of responses of body to different temperature and osmotic challenges. • exercise causes loss of water through sweating • will use up much of the sugar for energy/respiration/exercise • exercise causes loss of salts through sweating AO2.1 Apply knowledge and understanding of scientific ideas to identify drink requirements pre-race and post-race • pre-race drink needs to provide the body with sugar needed for exercise • post-race drink will need to replace salts lost / replace sugars used up AO3.2b Analyse information and ideas to make judgements about which sports drink is best for pre-race and post-race. • hypertonic is best for pre-race as it contains the highest levels of sugars / is taken 60 minutes before race as takes time to be absorbed / absorbed slowly so it's effects last for the race • isotonic drink after the race will not change / dilute / increase the

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
	<i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) demonstrates knowledge and understanding of one body response to different temperature and osmotic challenges OR applies knowledge and understanding to identify a drink requirement either pre-race or post-race. OR analyses information and ideas to explain which sports drink is best for either pre-race or for post-race <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>		concentration of the blood / will match the concentration of body fluids Examiner's Comments This is the Level of Response question on this paper. For a level three answer, examiners were looking for an explanation of why the water, salt and sugar levels would change during the race. This should then be coupled with the function of the drinks before and after the race. An explanation for the timing and choice of the drinks should also be included. Exemplar 4 shows a level 2 answer, which does not explain the choice of the isotonic drink after the race. Exemplar 4 The race causes him to sweat which releases water and salt leaving him with less. whilst running his body would have respired using glucose stores that decrease his sugar levels. The Hypertonic drink contains more sugars which provide him with more energy, it is also absorbed over a longer time which will help him through the so long race. after the race he drinks an isotonic drink which regulates his sugar levels to the optimum. This is done over a quicker period of time as he will not be using as much energy needing

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c		Any four from: glucose (in filtrate but) not in urine so must be reabsorbed✓ sodium chloride lower in urine so reabsorbed✓ urea (much) higher in urine so not reabsorbed✓ others higher in urine so not reabsorbed✓ waste products higher in urine so not reabsorbed but useful substances reabsorbed✓	4 (AO 3.2b)	IGNORE unqualified responses e.g. glucose is reabsorbed If no other mark awarded ALLOW some substances reabsorbed but others are not <u>Examiner's Comments</u> This question differentiated quite well. Some candidates used data from the two pie charts to back up their answers, whereas less successful candidates answered in general terms.
			Total	12	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
34			(Diagram B) because vasodilation ✓ (blood vessels) release more heat / energy (to environment) ✓ sweat being released to <u>evaporate</u>	3 (AO 1.1) (AO 2 × 2.1)	if A chosen award no marks ALLOW blood vessels/arterioles have widened / dilated idea of more heat released must be linked to blood vessels IGNORE cools down more ALLOW sweat not evaporated due to humidity preventing evaporation <u>Examiner's Comments</u> This was a well answered question, with many candidates gaining three marks. The lack of reference to sweat evaporating to cool the skin down was the most common omission.
			Total	3	
35			A	1 (AO 2.1)	
			Total	1	
36			D	1 (AO 2.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
37	a	i	insulin ✓	1 (AO 1.1)	<u>Examiner's Comments</u> This AO1.1 question was answered correctly by many candidates, but a number of candidates did not respond.
		ii	Any two from: secreted / released from glands/endocrine cells ✓ travel in blood(stream) ✓ affect target organs / cells ✓	2 (AO 1.1)	ALLOW named gland ALLOW hormones bind to specific receptors <u>Examiner's Comments</u> Another AO1.1 question that proved challenging for many. Where candidates did provide responses, many wrote about examples of what hormones can do but not how. There was a big focus on hormones affecting either puberty or fight/flight responses, but these did not gain any marks as they only wrote in their responses 'hormones make you emotional' or 'adrenaline gets you ready for action' and had not identified where they were produced, or how they got to different parts of the body.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	*Please refer to the marking instructions of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Correctly compares differences in insulin and glucose levels and identifies each person with evidence from the graphs. AND Describes the treatment for Type 1 and Type 2 diabetes. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Correctly identifies at least one of the people who are diabetic/healthy AND Describes the treatment for Type 1 or Type 2 diabetes. OR Correctly compares differences in insulin and glucose levels in at least one person. AND Describes the treatment for Type 1 or Type 2 diabetes. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Correctly identifies at least one of the people who are diabetic/healthy. OR Correctly compares differences in insulin and glucose levels in at least one person. OR Describes the treatment for Type 1 or Type 2 diabetes. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i>	6 (AO 2x 1.1) (AO 2x 2.1) (AO 2x 3.2a)	AO1.1 Demonstrates knowledge and understanding of scientific ideas to describe how diabetes is controlled - Type 1 diabetes needs insulin injections - Type 2 diabetes needs a carefully managed diet/avoid high sugar intake/regular exercise/take diabetic medication/pills AO2.1 Applies knowledge and understanding of scientific ideas in describing the differences in the glucose and insulin levels - In person A the insulin levels increase and return the glucose levels to normal - In person B insulin levels remain low and glucose levels are very high and not reduced - In person C insulin is produced (but slowly) and glucose levels are slow to be reduced/do not return to normal - Persons B and C have higher resting glucose levels AO3.2a Analyse information and ideas to make judgements and draw conclusions about the type of diabetes each person has - Person A is healthy - Person B and C have diabetes - Person B has Type 1 diabetes - Person C has Type 2 diabetes <u>Examiner's Comments</u> This question covering AO1, AO2 and AO3 discriminated well. Most candidates gained at least L1, by identifying at least one person or describing a treatment. Many got L2, by identifying and describing the patterns on the graphs and identifying the treatments/people. Relatively few

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			0 marks No response or no response worthy of credit.		candidates got up to L3, as there was often a mistake in identifying which person was healthy, Type 1 or Type 2. Many thought the third graph was the healthy person due to the correlation in pattern. Exemplar 2 Person A shows that the hormone and glucose are working at the same rate. At 1.5 hours both the hormone and glucose reach its peak then decreases. This shows that the person is healthy. Person B shows high levels of glucose and very little of the hormone. At 4 hours the person reaches 400 mg/dL of glucose. This shows that the person has type 1 diabetes as they are unable to produce the hormone/insulin. Person C has an increase of the hormone overtime and the glucose level begins to decrease between 2-3 hours. This shows that the person has type 2 diabetes. Person B with type 1 diabetes can control their glucose levels by injecting themselves. Type 2 can be controlled with exercise and maintaining a healthy lifestyle. Here, the candidate has identified all people, with good evidence from graph for each. Treatments have been given for both types, but Type 1 does not specify what to inject. So L3 5 marks as treatment for type 1 lacked full communication but there was sufficient communication of Type 2 with exercise & healthy lifestyle being identified.
	b		kidney ✓	1 (AO 1.1)	Examiner's Comments Candidates in the main were able to identify the kidney in this AO1.1 question. However, examples were seen where the liver, bladder and pancreas had been identified.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c		Any two from: drugs shape is same as substrate ✓ blocks the active site ✓ denature the enzyme ✓ change (shape of) active site ✓	2 (AO 2.1)	ALLOW drug is competitive/non-competitive inhibitor ALLOW competes with enzyme for active site NOT kill the enzyme ALLOW drug deforms enzyme/active site ALLOW substrate doesn't fit the active site/not complimentary ALLOW key doesn't fit the lock <u>Examiner's Comments</u> This AO2.1 question was answered well by higher ability candidates. Most candidates realised the enzyme could denature. Some went further to describe what this meant in terms of the shape of the enzyme.
			Total	12	
38			D	1 (AO 1.1)	
			Total	1	
39			C	1 (AO 2.1)	
			Total	1	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
40	Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Detailed explanation of how low levels of Na⁺ affects the blood and how this can affect cells. AND Explains the effect of blocking ADH and suggests how this can correct the condition. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Explains how low levels of Na⁺ affects the blood or how this can affect cells AND explains the effect of blocking ADH or suggests how this can correct the condition OR Explains how low levels of Na⁺ affects the blood and how this can affect cells. OR Explains the effect of blocking ADH and suggests how this can correct the condition. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Describes how low levels of Na⁺ affects water potentials. OR Describes the effect of blocking ADH. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>	6 (AO 3 x 1.1 3 x 2.1)	AO1.1 Demonstrates knowledge and understanding of scientific ideas to explain how low levels of Na⁺ affects the blood • blood is hypotonic / less concentrated / higher water potential AO2.1 Applies knowledge and understanding of scientific ideas to explain how low levels of Na⁺ affects cells • water enters cells by osmosis / as cells are more concentrated / lower water potential than the blood • cell membrane becomes overstretched / lysis may happen / cells will burst AO1.1 Demonstrates knowledge and understanding of scientific ideas to explain the effect of blocking ADH • blocking ADH makes the kidney tubule less permeable/less water reabsorbed • blocking ADH increases the volume of water lost from the body/present in urine / urine becomes more dilute AO2.1 Applies knowledge and understanding of scientific ideas to suggest how blocking ADH can correct the condition • blood concentration is increased / water potential lowered / water would move out of cell / water will not move into cells • eventually blood and cells are isotonic/same concentration/same water potential/same sodium ion concentration <u>Examiner's Comments</u> A number of candidates did not commit themselves as to whether the body cells would lose or take up water and explained both possibilities. Incorrect references to turgidity were also seen. There was also confusion regarding the role of ADH, with a

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					number of candidates stating that it makes the body pass out more water. Exemplar 4 shows a clear, correct Level 3 answer. Exemplar 4 Low sodium ion levels can cause a person's cells to be ~~dehydrated~~ overhydrated which puts them at risk of bursting. This is because the water potential of the blood will be higher than that of the cells. Through osmosis, water moves into those cells and if too much enters the cells could burst. ADH is the anti-diuretic hormone and it prevents water from being lost through urine by causing the kidneys to reabsorb it into the blood. Drugs blocking this action would cause more ~~water~~ to be lost during urination as not as much would be reabsorbed. This would lower the water potential of the blood and reduce the amount of water entering cells, reducing the chance of cells undergoing lysis and bursting.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
41	a		glucagon ✓	1 (AO 1.1)	
	b	i	(person) C ✓	1 (AO 3.2a)	<u>Examiner's Comments</u> A significant number of candidates thought that candidate A had type 2 diabetes. Others confused type 1 with type 2 and so chose option B.
		ii	insulin is produced/released / insulin level is high ✓ idea that ability to control glucose levels is reduced ✓	2 (AO 2.1)	mark independently of (d)(i) ALLOW idea that body is resistant to insulin <u>Examiner's Comments</u> Confusion between type 1 and type 2 diabetes was seen in a number of the candidates' responses. Some however explained type 2 diabetes clearly and concisely and so scored both marks. This is shown in exemplar 5. Exemplar 5 Insulin is being produced due to the high levels of glucose however because the person is resistant to insulin glucose levels don't rapidly decrease when insulin peaks [2]

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c		embryonic stem cells are able to differentiate into any cell / totipotent / adult stem cells are limited / pluripotent ✓ therefore insulin producing cells are easier to develop from embryonic stem cells/adult stem cells are not ✓	2 (AO 1.1) (AO 2.1)	IGNORE adult stem cells are already specialised ALLOW difficult to locate adult stem cells IGNORE embryonic stem cells can repair all parts <u>Examiner's Comments</u> The majority of candidates correctly explained the totipotent nature of embryonic stem cells but few candidates went on to explain the consequences of this in replacing pancreatic cells. Exemplar 6 shows an example of a common answer that only scores the first marking point. Exemplar 6 embryonic stem cells can specialise to become any type of cell whereas adult stem cells can only specialise to become a cell from their own tissue [2]
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
42		i	Any two from: idea it affects enzymes (action/structure) ✓ high temperature causes active site to change shape / active site denatures ✓ stops them working ✓	2 (AO1.1)	ALLOW enzymes are heat sensitive/denature ALLOW enzymes cannot bind to substrate molecules IGNORE cells denature ALLOW enzymes no longer catalyse reaction

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Demonstrates knowledge of homeostasis. AND Applies knowledge of a skin mechanism for maintaining body temperature in different environments. AND Analyses information to comment on the effect of exposing skin. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Demonstrates knowledge of homeostasis and applies knowledge of a skin mechanism for maintaining body temperature in different environments. OR Demonstrates knowledge of homeostasis and analyses information to comment on the effect of exposing the skin. OR Applies knowledge of a skin mechanism for maintaining body temperature in different environments and analyses information to comment on the effect of exposing skin. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Demonstrates knowledge of homeostasis. OR Applies knowledge of a skin mechanism for maintaining body temperature in different environments. OR Analyses information to comment on the effect of exposing skin.	6 (AO2 x 1.1) (AO2 x 2.1) (AO2 x 3.1a)	AO1.1 Demonstrate knowledge and understanding of skin and homeostasis • need to keep constant internal temperature, despite the different external temperatures • person A needs to lose heat to the environment / person B needs to reduce heat lost to the environment • person A gains heat from the environment / person B loses heat to the environment • person A will be in danger of overheating / person B will be in danger of becoming too cold. AO2.1 Apply knowledge and understanding of the mechanisms in skin for maintaining body temperature in different environments • cold environment reduces sweating /decreases blood flow to the skin (vasoconstriction) / shivering / body hairs rise • warm environment increases sweating / increases blood flow to the skin (vasodilation) / body hairs on skin lie flat AO3.1a Analyse information and ideas to interpret the effect of exposing / covering skin in different environments • person A body less covered/more exposed skin in warmer conditions increases heat loss/allows sweat to evaporate • person B body covered/less exposed skin in colder conditions reduces heat loss/stops sweat evaporating

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			<i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>		
			Total	8	
43			cells absorb water ✓ by osmosis ✓ red blood cells/cytoplasm swells / increased pressure in the cell/on the cell membrane / <u>cell membrane</u> ruptures/bursts ✓	3 (AO3 x 1.1)	IGNORE references to water potential IGNORE just cell bursts
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance										
44	a	i	The higher the BMI then the higher the mass of urea (in urine) / ORA ✓	1 (AO2.1)	ALLOW positive correlation IGNORE they are directly proportional IGNORE linear relationship										
		ii	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.0016 (g/cm ³) award 2 marks 1.6 ÷ 1000 ✓ = 0.0016 (g/cm ³) ✓	2 (AO2.2)	ALLOW 1.6 x 10 ⁻³										
		iii	idea that there is a greater increase in mass of urea as BMI increases in Fig 22.2/second graph ✓ idea that first graph/22.1 has stronger correlation / more points closer to line of best fit / less spread of data ✓	2 (AO2 x 3.2b)	ALLOW larger mass of urea per BMI gained ALLOW line is steeper/higher gradient in Fig22.2 IGNORE higher BMI for greater mass of urea ALLOW second graph does not follow the line of best fit so closely										
	b		<table border="1"><tr><td>Bowman's capsule</td><td>1</td></tr><tr><td>Collecting duct</td><td>5</td></tr><tr><td>Proximal convoluted tubule</td><td>2</td></tr><tr><td>Loop of Henlé</td><td>3</td></tr><tr><td>Second coiled region</td><td>4</td></tr></table> ✓✓✓	Bowman's capsule	1	Collecting duct	5	Proximal convoluted tubule	2	Loop of Henlé	3	Second coiled region	4	3 (AO3 x 1.1)	5 before 2 ✓ 2 before 3 ✓ 3 before 4 ✓
Bowman's capsule	1														
Collecting duct	5														
Proximal convoluted tubule	2														
Loop of Henlé	3														
Second coiled region	4														
			Total	8											

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
45		i	Yes (no marks) cooler than black/grey skin OR Yes (no marks) lighter skin is cooler OR No (no marks) zebra skin was similar temperature to the other barrels OR No (no marks) idea it is warmer than the barrel covered by the white skin / ORA ✓	1 (AO3.2a)	argument must support decision
		ii	paint the barrels different colours rather than using the skins / use the same type of skin painted different colours OR idea to make sure that thicknesses/SA/V /volume/temperature of water in barrel need to be controlled ✓	1 (AO3.3a)	ALLOW use painted towels to cover barrels ALLOW for same type of skin e.g. hair-free skin
			Total	2	
46			A ✓	1 (AO2.1)	
			Total	1	
47			cells absorb water ✓ by osmosis ✓ (red blood) cells/cytoplasm swells / increased pressure in the cell/on the cell membrane / <u>cell membrane</u> ruptures/bursts ✓	3 (AO3 x 1.1)	IGNORE references to water potential IGNORE just cell bursts
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance										
48	a	i	The higher the BMI then the higher the mass of urea (in urine) / ORA ✓	1 (AO2.1)	ALLOW positive correlation IGNORE they are directly proportional IGNORE linear relationship										
		ii	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.0016 (g/cm ³) award 2 marks 1.6 ÷ 1000 ✓ = 0.0016 (g/cm ³) ✓	2 (AO2.2)	 ALLOW 1.6 x 10 ⁻³										
		iii	idea that there is a greater increase in mass of urea as BMI increases in Fig 17.2/second graph ✓ idea that first graph/17.1 has stronger correlation / more points closer to line of best fit / less spread of data ✓	2 (AO2 x 3.2b)	ALLOW larger mass of urea per BMI gained ALLOW line is steeper/higher gradient in Fig17.2 IGNORE higher BMI for greater mass of urea ALLOW second graph does not follow the line of best fit so closely										
	b		<table border="1"><tr><td>Bowman's capsule</td><td>1</td></tr><tr><td>Collecting duct</td><td>5</td></tr><tr><td>Proximal convoluted tubule</td><td>2</td></tr><tr><td>Loop of Henlé</td><td>3</td></tr><tr><td>Second coiled region</td><td>4</td></tr></table> ✓✓✓	Bowman's capsule	1	Collecting duct	5	Proximal convoluted tubule	2	Loop of Henlé	3	Second coiled region	4	3 (AO3 x 1.1)	5 before 2 ✓ 2 before 3 ✓ 3 before 4 ✓
Bowman's capsule	1														
Collecting duct	5														
Proximal convoluted tubule	2														
Loop of Henlé	3														
Second coiled region	4														
			Total	8											

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
49		i	polymers ✓ monomers ✓	2 (AO2 x 1.1)	
		ii	(A has) less ADH released/present ORA ✓ so less/no reabsorption of water / permeability of collecting duct is lower/has not changed ✓	2 (AO2 x 2.1)	ALLOW ADH release is inhibited in A / lack of ADH production in A IGNORE less movement of water out of the tubule (must state reabsorption)
		iii	Any two from: (low) water potential/(decreased) water levels are detected by hypothalamus ✓ will cause the release of ADH/ increased ADH levels ✓ increased permeability of collecting duct/kidney tubules / increased reabsorption of water (into blood) / decreased urine production / urine will become more concentrated ✓	2 (AO2 x 2.1)	IGNORE brain
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
50	a	i	Yes (no marks) cooler than black/grey skin OR Yes (no marks) lighter skin is cooler OR No (no marks) zebra skin was similar temperature to the other barrels OR No (no marks) idea it is warmer than the barrel covered by the white skin / ORA ✓	1 (AO3.2a)	argument must support decision
		ii	paint the barrels different colours rather than using the skins / use the same type of skin painted different colours OR idea to make sure that thicknesses/SA/V /volume/temperature of water in barrel need to be controlled ✓	1 (AO3.3a)	ALLOW use painted towels to cover barrels ALLOW for same type of skin e.g. hair-free skin
	b	i	Any two from: zebras with stripes attracts less/fewer insects / ORA✓ narrower stripes attract less insects / ORA ✓ stripe width for least number of insects/optimum protection is about 8cm / stripe width for most number of insects is about 25cm ✓	2 (AO2x3.1 a)	ALLOW insect bites for insects IGNORE length of stripe ALLOW width range between 5-10cm for least number of insects / most number of insects is 22-27cm
		ii	stripe width of 8cm because it is the lowest point on the graph/fewest number of insects ✓	1 (AO3.2a)	ALLOW width tolerance between 7-9cm and least number of insects (on tape)

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	Any three from: stripes developed as a mutation / variation for skin stripes ✓ (animals with stripes) less likely to be bitten by insects / more healthy / spread less pathogens / ORA ✓ (striped animals) more likely to survive ✓ (striped animals) more likely to reproduce ✓ pass on allele/gene for stripes / ORA ✓ process occurs over many generations ✓	3 (AO3 x 2.1)	ALLOW some more striped than others ALLOW offspring produced / breed together IGNORE selective breeding ALLOW pass on advantageous gene IGNORE trait is passed on / genes are passed on IGNORE over time
			Total	8	
51		i	use Benedicts (reagent) ✓ heat / boil ✓ no change in colour / stays blue / does not go red ✓	3 (AO3 x 1.2)	
		ii	Yes (no mark) blood sugar levels will be controlled/not rise ✓ idea of a sugar replacement ✓	2 (AO1 x 3.2a) (AO1 x 2.1)	If No chosen = 0 marks IGNORE blood sugar levels will decrease ALLOW less sugar eaten
			Total	5	