OCR
Oxford Cambridge and RSA

Accredited

GCSE (9–1) Biology B (Twenty First Century Science) F

J257/01 Breadth in biology (Foundation Tier)

Sample Question Paper

Date – Morning/Afternoon

Version 2

Time allowed: 1 hour 45 minutes

You may use:
- a scientific or graphical calculator

First name									
Last name									
Centre number						Candidate number				

INSTRUCTIONS
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Complete the boxes above with your name, centre number and candidate number.
- Answer all the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do not write in the bar codes.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- This document consists of **28** pages.

Answer **all** the questions.

1 **(a)** In humans, sex is determined by chromosomes.

Write down the combination of sex chromosomes in the body cells of females and males.

Females ..... Males..... **[1]**

(b) In alligators, sex is determined by the temperature at which the fertilised eggs are incubated.

(i) The data below shows the effect of temperature on sex determination in alligators.

Temperature (°C)	Number of females	Percentage of females (%)	Number of males	Percentage of males (%)
30	0	0	15	100
31	7	46.7	8	53.3
32	9		6	
33	15	100	0	0

Calculate the percentage of alligators that hatched as males and females when the eggs are incubated at 32 °C.

Females ..... % Males ..... % **[2]**

(ii) What can be concluded about the effect of temperature on sex determination in alligators?

.....

.....

.....

..... **[2]**

(c) (i) Alligators eat fish, birds, turtles and snakes.

These foods are high in protein.

Put a tick (✓) in the box that describes what proteins are made of.

Amino acids ☐

Fatty acids ☐

Glycerol ☐

Sugars ☐ **[1]**

(ii) Describe a test that could be used to show if these foods contain protein.

.....

.....

.....

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

(d) (i) Alligators are unable to control their own internal temperature.
They rely on external sources of heat to regulate their body temperature.

Alligators are most active at 33 °C.

Put a tick (✓) in the box that best explains why.

There will be more collisions between enzymes and substrates so reactions will happen faster. ☐

The enzymes will be denatured so reactions will slow down. ☐

There will be fewer collisions between enzymes and substrates so the reactions will happen slower. ☐

There will be no collisions between enzymes and substrates so no reactions will happen. ☐ **[1]**

(ii) Humans are able to control their internal temperature.

Describe the appearance of human skin when the temperature drops.

.....

.....

..... **[2]**

(iii) Humans need to be able to maintain a constant environment within their bodies, within very narrow limits.

What is this called?

..... **[1]**

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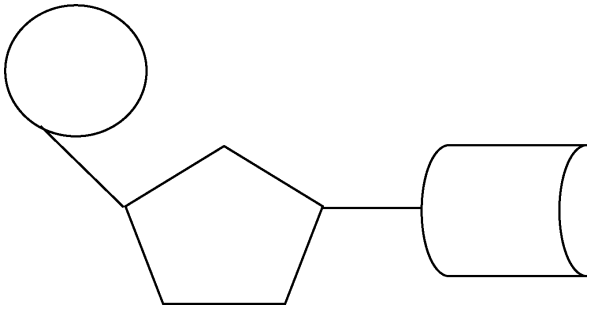
TURN OVER FOR THE NEXT QUESTION

2 **(a)** **(i)** DNA is a polymer made of nucleotides.

Each nucleotide is made of three parts:

- A phosphate group
- A base
- A sugar

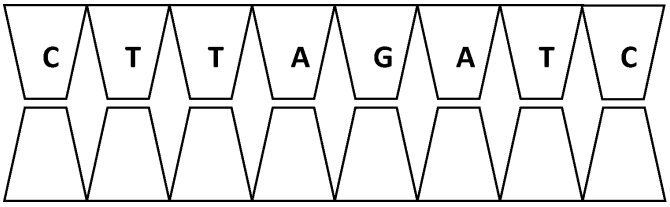
Label the phosphate group on the nucleotide below.



[1]

(ii) DNA has four different bases: A, T, C and G.

Use these four bases to complete the base sequence of the complementary strand of DNA.



Complementary strand

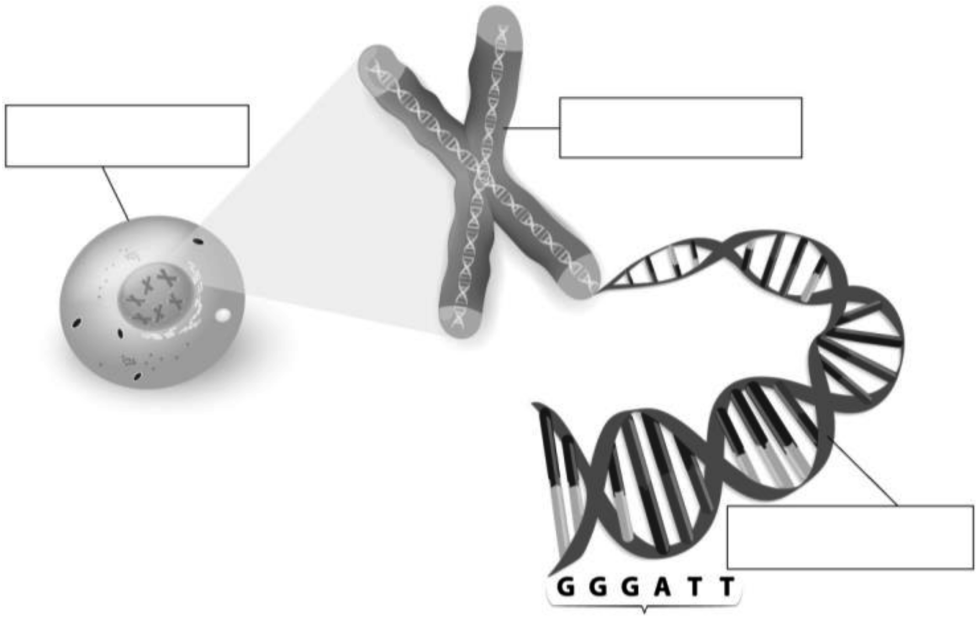
[1]

(b) The diagram below shows how genetic material is organised.

Choose a word from the list to label each structure.

base pair **cell** **chromosome** **DNA** **gene** **nucleus**

Add the correct word in the boxes.

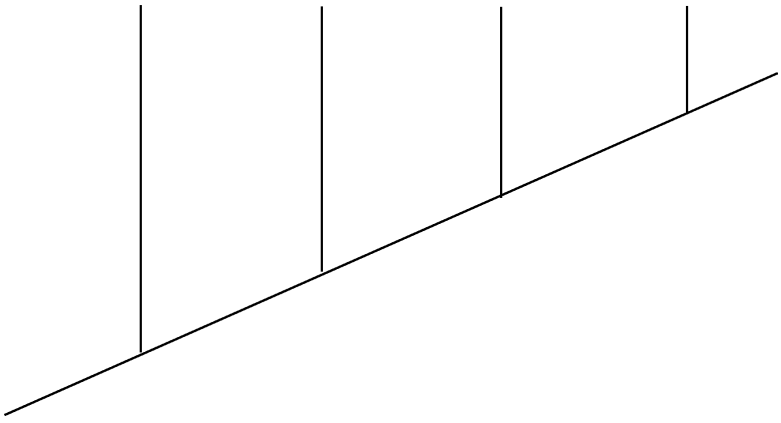


[3]

(c) **(i)** DNA has been used to help classify organisms. The more DNA that we have in common with another species, the more closely related we are to them.

This relationship can be shown in a diagram.

Orang-utans Gorillas Chimpanzees Humans



Which species are humans most closely related to?

..... **[1]**

(ii) Scientists think chimpanzees are intelligent animals.

Which part of the brain is associated with intelligence?

Put a tick (✓) in the correct box.

Brain stem ☐

Cerebral cortex ☐

Cerebellum ☐

Hypothalamus ☐ **[1]**

(d) (i) The nervous system consists of billions of neurons.

An electrical impulse can travel down a neuron at different speeds.

Neuron	Length (m)	Time taken for impulse to travel (s)	Speed (m/s)
A	1.3	0.027	48.15
B	1.3	0.014	
C	0.8	0.022	

Calculate the speed of the electrical impulse travelling down neuron **B** and neuron **C**.

Neuron **B** speed =.....m/s

Neuron **C** speed =.....m/s **[2]**

(ii) One of these neurons has a fatty substance wrapped around its axon.

Which neuron, **A**, **B** or **C**, has a fatty substance wrapped around its axon?

Use data from the table in **(d)(i)** to justify your choice.

Neuron .....

Justification .....

..... **[2]**

(e) In a reflex arc, the components of the nervous system work together.
The order of these components is important.

The sequence is described below but the events are in the wrong order.

1. A sensory neuron sends an impulse to a relay neuron.

2. An effector produces a response.

3. A receptor detects a stimulus.

4. A motor neuron sends an impulse to an effector.

Place the events in the correct order using the numbers.

The first event has been done for you.

3 _____ _____ _____ _____ **[2]**

3 Jack grows tomatoes in his greenhouse.

(a) (i) Jack needs to water his tomato plants regularly.

The water will be moved through the tomato plant by the xylem.

Which sentence best explains how the xylem is adapted to its function?

Put **one** tick (✓) in the correct box.

Companion cells contain mitochondria to release energy. ☐

Perforated plates allow movement between cells. ☐

Cells are joined end to end with no connecting cell walls. ☐

Cells are joined end to end and contain cytoplasm. ☐ **[1]**

(ii) It is a lovely summer's day in Jack's greenhouse.

Various factors affect the rate of photosynthesis including:

- light intensity
- temperature
- carbon dioxide concentration.

Which **one** of the factors above is likely to limit the rate of photosynthesis of Jack's tomato plants?

Explain your answer.

.....

.....

.....

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

(b) (i) One morning Jack notices that the leaves of his plant look different.

The tomato plant has a disease called blight.

Before **After**

Suggest how blight may affect the plant.

.....

..... **[1]**

(ii) Pesticides can be used to try to kill plant diseases such as blight on tomato plants.

State **one** way that a plant can naturally defend itself against pathogens.

.....

..... **[1]**

(c) Fill in the gaps in the paragraph below with the best term from the list.

chromosomes **genes** **immune** **natural selection**

offspring **resistant** **selective breeding**

Awheat breeder notices that some of his wheat plants do not die when attacked by a fungus.

These plants are ..... to the fungus. He uses these plants to breed from and selects from their ..... to breed the next generation. This is an example of ..... **[3]**

(d) **(i)** Some human diseases are not caused by microorganisms but are inherited.

Cystic fibrosis is an example of a disease that is inherited. It is caused by a recessive allele.

Cystic fibrosis alleles: F = dominant f = recessive

Which of the following genotypes would result in the person being affected by cystic fibrosis?

Put a tick (✓) in the correct box.

FF ☐

Ff ☐

fF ☐

ff ☐ **[1]**

(ii) Two parents have a genotype Ff.

Work out the probability of them having a child with cystic fibrosis.

		Mother	
		F	**f**
Father	**F**		
	f		

Probability = ...**[2]**

4 A group of students want to investigate the effect of temperature on living things.

They do an experiment on *Daphnia* (water fleas).

Daphnia

Daphnia are very small organisms. The students view the *Daphnia* using a light microscope.

It is possible to observe the heart of the *Daphnia* beating using the microscope.

- The group place *Daphnia* in water at different temperatures.
- They look at the effect of different temperatures on the heart rate of the *Daphnia*.

Their results are shown below.

Temperature (ºC)	Heart rate of *Daphnia* (beats per minute)				
	Group A	Group B	Group C	Group D	Mean
17	25	22	25	24	24
20	27	27	25	25	26
23	30	30	30	34	31
25	33	57	36	39	36

(a) What conclusion can the students draw about their experiment?

.....

..... **[1]**

(b) The students used a Bunsen burner to maintain the temperature of the water that the *Daphnia* were kept in.

Explain why this is **not** a good method and suggest an improvement.

.....

.....

..... **[2]**

(c) *Daphnia* are living organisms.

What might be an ethical concern with this experiment?

..... **[1]**

(d) The students could see the *Daphnia*'s heart beating.

In humans the heart forms part of the circulatory system.

What role does the heart play in a circulatory system?

..... **[1]**

(e) Which organ is responsible for maintaining the water balance of the blood?

Put a tick (✓) in the correct box.

Heart ☐

Kidneys ☐

Lungs ☐

Skin ☐ **[1]**

(f) The skin contains stem cells. Stem cells are unspecialised cells.

How does this make them useful to scientists?

.....

.....

..... **[2]**

(g) Cells contain mitochondria.

What is the function of the mitochondria in the cell?

Put a tick (✓) in the correct box.

Control entry and exit of substances into the cell ☐

Responsible for photosynthesis ☐

Make ATP ☐

Store genetic information ☐ **[1]**

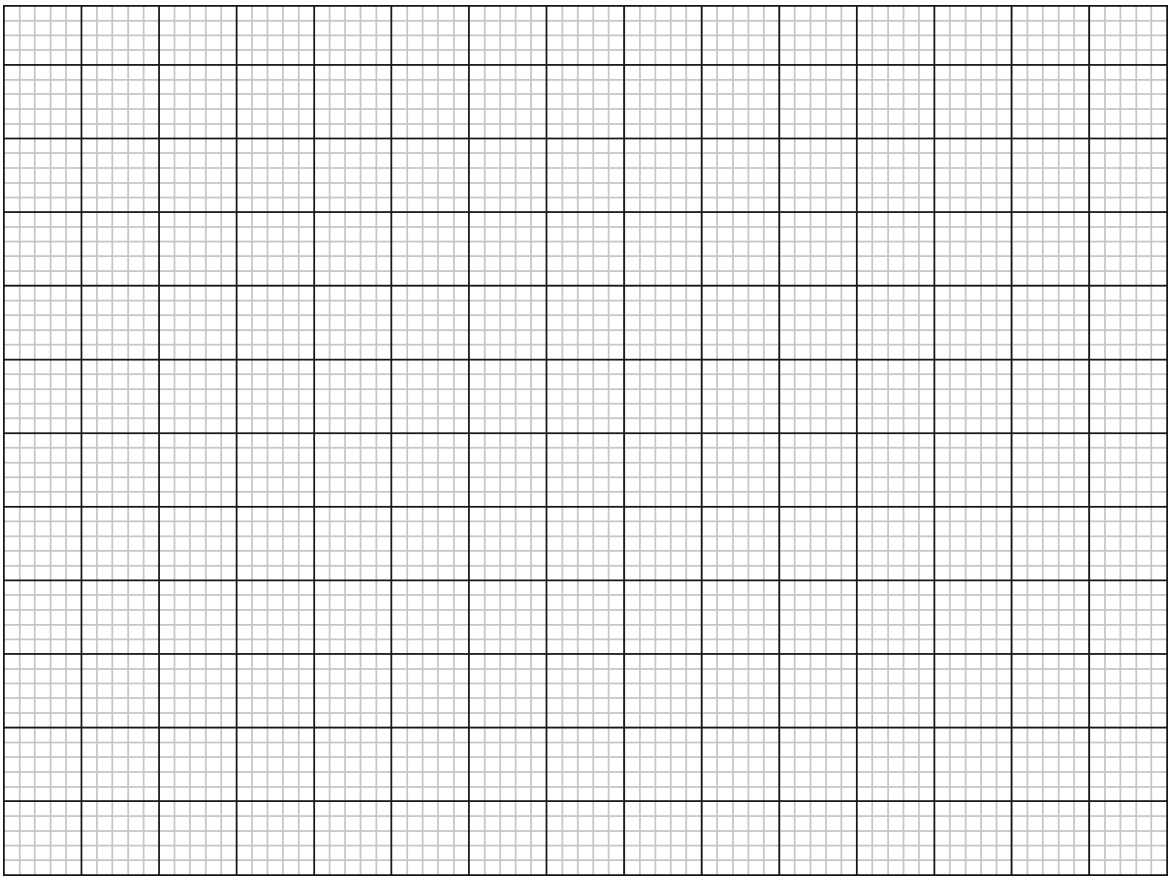
(h) Mitochondria contain enzymes.

A student investigates the effect of temperature on the rate of a reaction involving an enzyme in the mitochondria.

His results are shown below.

Temperature (°C)	Rate of reaction (arbitrary units)
0	**0**
20	**10**
30	**20**
40	**40**
50	**10**
60	**0**

(i) Plot the results in the table on the grid below. **[3]**



(ii) Use the points to draw a curve through all the plots. **[1]**

(iii) Use the graph to find the rate of the reaction at 10 °C.

Rate of reaction = ... arbitrary units **[1]**

(iv) The student does not think that the results give an accurate measurement for the optimum temperature.

Suggest a further investigation that the student could do to increase the accuracy of the results.

.....

..... **[1]**

5 **(a)** **(i)** HIV is an infection which causes a weakened immune system.

State **two** ways of passing HIV from one person to another.

1 .....

2 ..... **[2]**

(ii) People with HIV are at risk from opportunistic infections.

- These infections take advantage of a weakened immune system.
- The most threatening infections occur when the person has a CD4 count less than 200.

Four individuals with HIV had their CD4 count measured.

Individual	CD4 count
1	500
2	210
3	160
4	175

Place the individuals in order of those with the greatest risk of contracting an opportunistic infection.

....

most risk **least risk**

[1]

(b) Tuberculosis is an example of an opportunistic infection.

The BCG vaccination was given to all UK children between the ages of 10 and 14 until 2005.
In 2005, this routine immunisation was stopped.

Why would the government stop vaccinating a population?

.....

..... **[1]**

(c) When bacteria enter the body, they multiply.
The body launches an immune response.

Name the type of proteins that the body produces to attack the multiplying bacteria?

Put a tick (✓) in the correct box.

Antibodies ☐

Antigens ☐

Antibiotics ☐

Enzymes ☐ **[1]**

(d) Some diseases are multifactorial diseases. This means that many factors contribute to their cause. Cardiovascular disease is an example.

Age and gender are known risk factors for coronary heart disease.

The data in the table below shows the number of deaths from this disease in 2007 in the UK.

Age (years)	Number of deaths in males	Number of deaths in females
Under 35	129	27
35 – 44	783	183
45 – 54	2 679	578
55 – 64	6 687	1 779
65 – 74	11 335	4 987

What can you conclude from the table about the effect of age **and** gender on the risk of death from cardiovascular disease?

.....

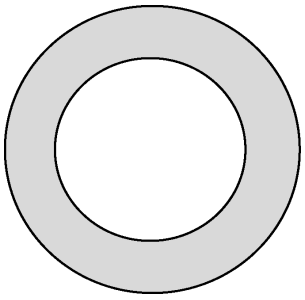
.....

.....

..... **[2]**

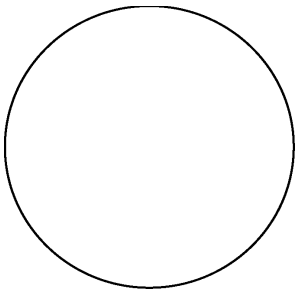
(e) (i) Many factors increase the risk of developing cardiovascular disease.

When Ali was a young boy, a section through a coronary artery (that supplies blood to the heart muscle) looked like this:



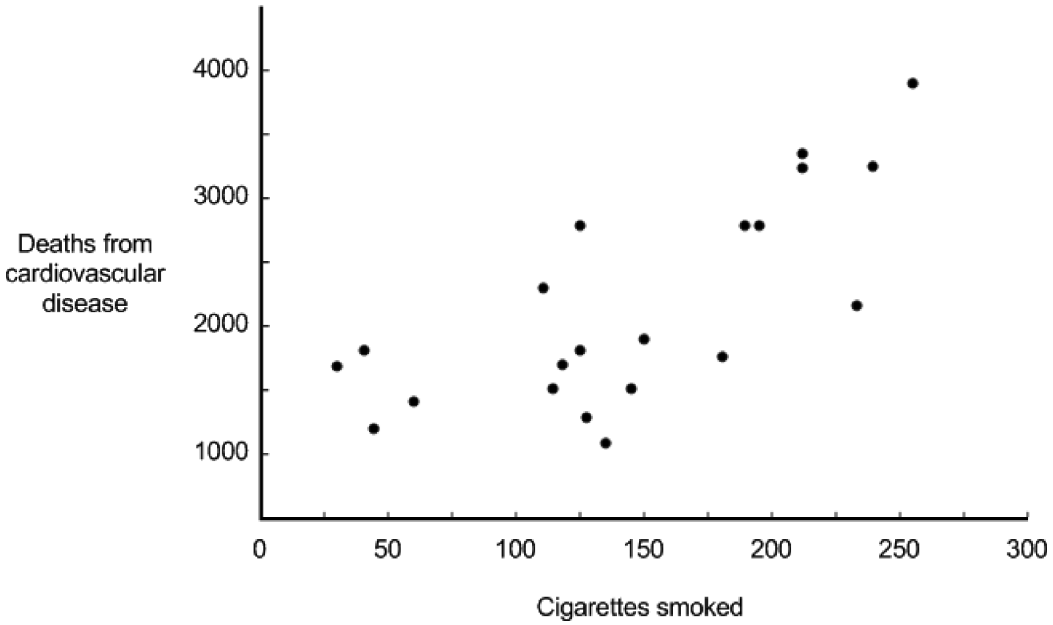
Ali has eaten a high fat diet for many years.

Complete the diagram below to show what Ali's coronary artery is likely to look like now.



[2]

(ii) Cigarette smoking can increase the risk of developing cardiovascular disease but does **not** necessarily lead to it.



Identify the type of correlation shown in the graph.

..... **[1]**

(iii) Ali smoked 40 cigarettes a day and died of old age when he was 95 years old.

Explain why this **cannot** be used as convincing evidence of a correlation between the risk of smoking cigarettes and developing cardiovascular disease.

.....

.....

.....

..... **[2]**

6 Sarah is feeling unwell and feels very tired. Her doctor thinks that she may have Chronic Fatigue Syndrome (CFS).

(a) CFS is difficult to diagnose.

Before diagnosis, doctors rule out a condition called anaemia by carrying out a blood test.

A blood test checks the number of blood cells in Sarah's blood.

(i) What is the role of **red** blood cells?

.....

..... **[1]**

(ii) Extreme tiredness is one symptom of CFS.

The table shows the results of Sarah's blood test.

	Red blood cell (per mm^3)	**White blood cell (per mm^3)**	**Platelets (per mm^3)**
Normal level	3 800 000	8 500	250 000
Sarah	2 700 000	9 000	245 000

Explain how the results in the table show the possible cause of Sarah's tiredness.

.....

.....

.....

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

(iii) The table below shows some information about red blood cells and cheek cells taken from a human.

	Red blood cell	**Cheek cell**
Surface area (μm^2)	136	7854
Volume (μm^3)	90	65 450
Surface area : volume ratio		0.12 : 1

Calculate the surface area : volume ratio of a red blood cell.

Show your working.

Give your answer to **two** significant figures.

Surface area : volume ratio = ... **[1]**

(iv) Red blood cells have a greater surface area : volume ratio than cheek cells.

Explain how this allows red blood cells to carry out their function.

.....

.....

..... **[1]**

(v) The doctor will check to see if Sarah has an underactive thyroid gland as this could also make her feel tired.

The thyroid gland produces a hormone.

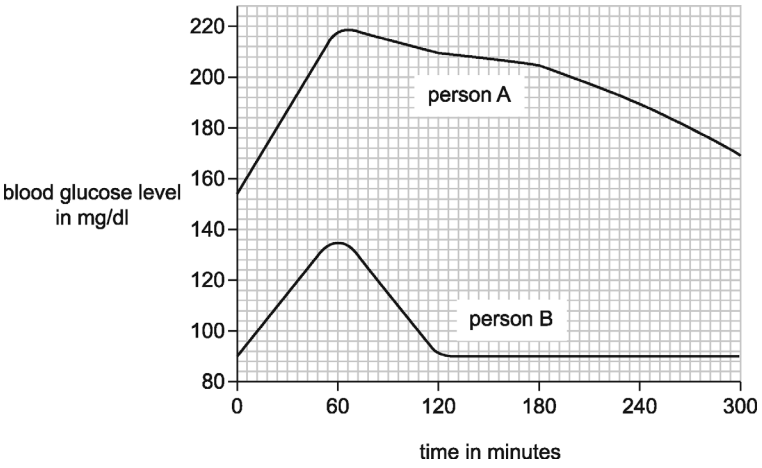
What is the role of a hormone?

..... **[1]**

(b) (i) Insulin is a hormone produced by the pancreas.

The graph below shows data from two people who were given a sugary drink.

Their blood sugar level was recorded every 60 minutes from when they had the drink.



There are two types of diabetes – type 1 and type 2.

- Person **A** has type 2 diabetes.
- Person **B** does not have diabetes.

Describe how the graph shows this and explain why there is a difference in the blood sugar level.

.....

.....

..... **[2]**

(ii) The statements below apply to type 1 and type 2 diabetes.

Draw **two** lines to link the sentences to **type 1 diabetes.**

Type 1 diabetes	body no longer responds to the insulin produced
	should eat a diet high in complex carbohydrates and exercise
	will need to inject insulin
	pancreas stops producing insulin

[2]

7 Limpets are molluscs that are found on rocky shores.

Limpet

A student wants to sample a rocky shore to work out if the population of limpets differs on different parts of the shore.

(a) Describe a method that the student could use to find out which parts of the rocky shore have more limpets.

.....

.....

.....

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

(b) The student counted the number of limpets on three parts of the rocky shore.

The results are shown in the table.

Part of shore	Number of limpets			
	Test A	**Test B**	**Test C**	**Mean**
Low shore (closest to sea)	15	16	17	
Mid shore	45	47	49	
High shore (furthest away from sea)	2	1	8	

(i) The student thinks that one of the results is an outlier.

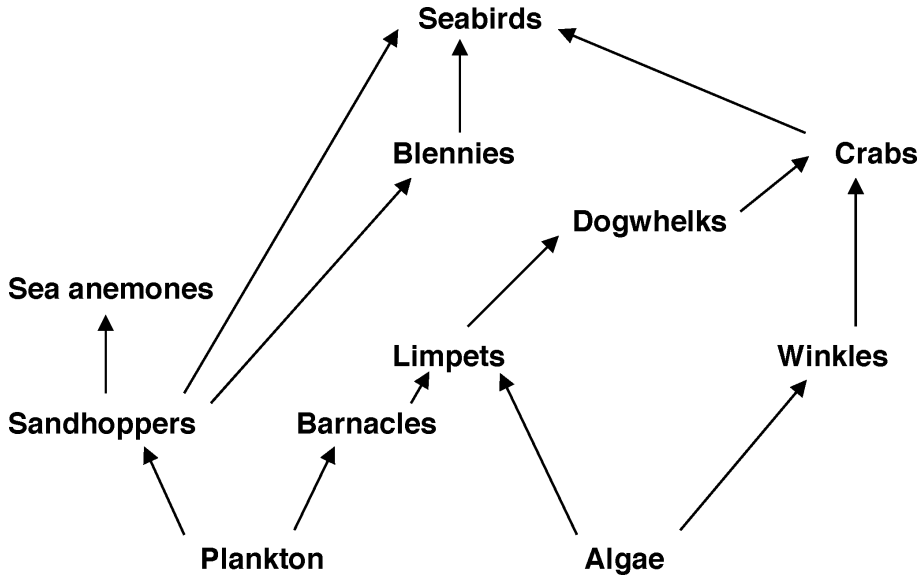
Circle the outlier in the table above. **[1]**

(ii) Calculate the mean number of limpets found on the mid shore.

Show your working.

Number = ... **[2]**.

(c) This is a food web for the species that can live on a rocky shore.



Explain the impact of an increase in the number of **dogwhelks** on one species in this food web.

.....

.....

.....

..... **[2]**

(d) In some areas of the UK, dogwhelk numbers are decreasing. This reduces biodiversity.

Give **two** benefits of maintaining biodiversity.

1 .....

.....

2 .....

..... **[2]**

(e) Sea anemones can reproduce asexually.

Give **one** advantage and **one** disadvantage of reproducing asexually.

Advantage .....

.....

Disadvantage .....

..... **[2]**

(f) **(i)** Sea anemones are mainly found in rock pools.

During the summer, the water temperature in a rock pool can increase. This can be dangerous for a sea anemone.

Put a tick (✓) in the box that best explains why this temperature increase is a problem.

Enzyme catalysed reactions will speed up. ☐

Enzyme catalysed reactions will slow down. ☐

Enzymes will be killed. ☐

Enzymes will become denatured. ☐ **[1]**

(ii) When it rains, the concentration of the sea water in a rock pool decreases.

What effect will this change in concentration have on a sea anemone's cells?

Put a tick (✓) in the box next to the correct answer.

Some cells may burst. ☐

Some cells may shrink. ☐

There will be no change to the cells. ☐

Some cells will burst. Other cells will shrink. ☐ **[1]**

END OF QUESTION PAPER