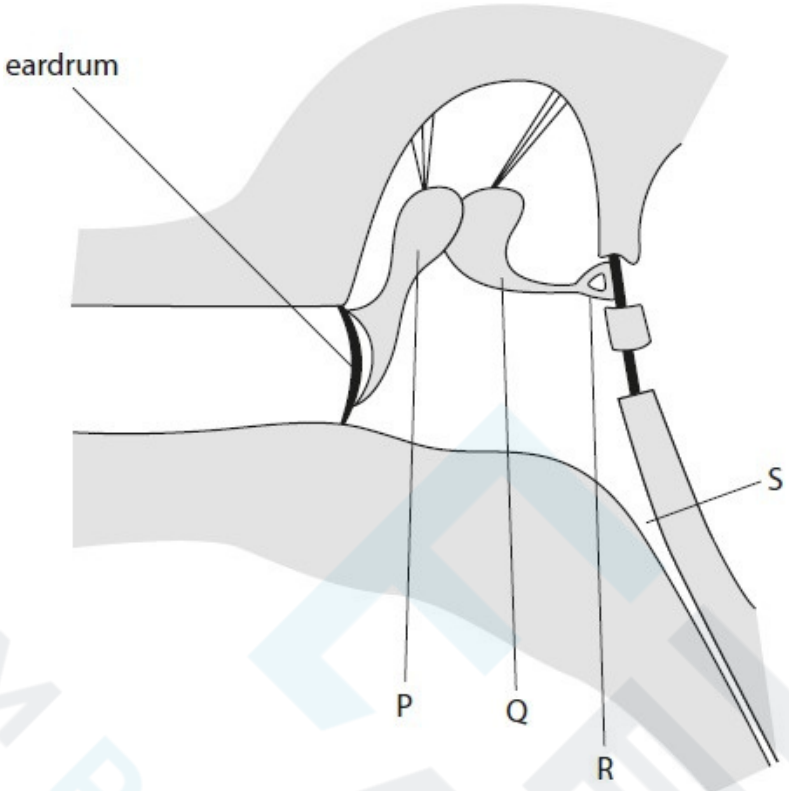
Q1.

The diagram shows part of a human ear.



(a) (i) Give the name of structure S.

(1)

.....

(ii) Name three parts of the ear that are **not** shown on the diagram.

(3)

1 .....

2 .....

3 .....

(b) (i) Describe the functions of structures P, Q and R.

(4)

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(ii) What is the name of the medium directly surrounding structures P, Q and R?

(1)

☒ **A** air

☒ **B** bone

☒ **C** fluid

☒ **D** oxygen

(c) Explain the importance of structure S in the process of hearing.

(3)

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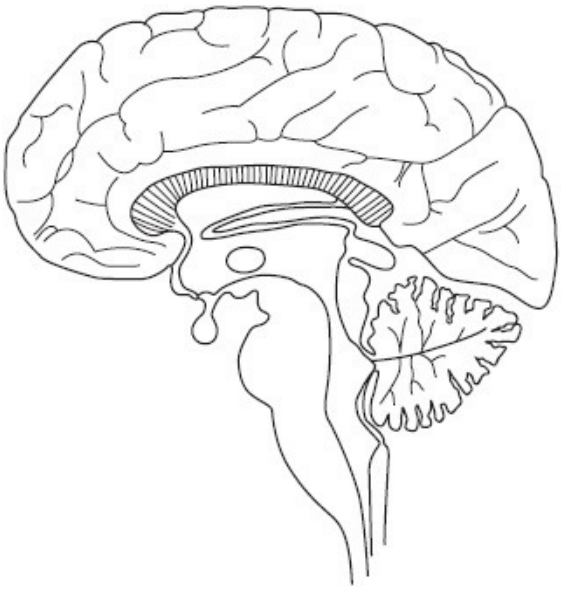
(Total for question = 12 marks)

Q2.

The diagram shows a section through a human brain.



(a) Using lines, label these structures on the diagram.

- cerebral hemisphere
- cerebellum
- pituitary gland
- hypothalamus

(4)

(b) State which structure in part (a) is responsible for each of these functions.

(4)

Function	Structure
control of muscle tone and posture	
intelligence and thought	
monitoring of body temperature	
release of ADH	

(Total for question = 8 marks)

Q3.

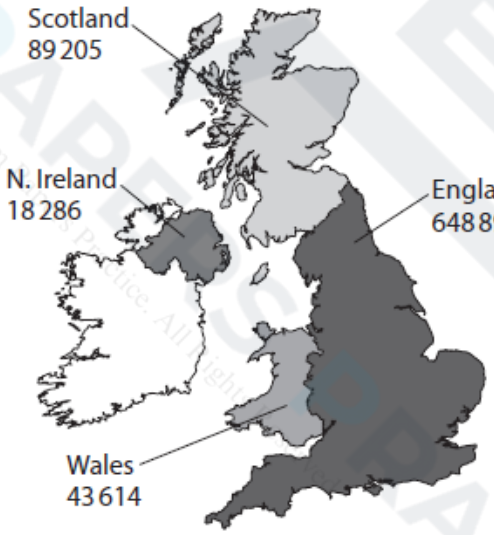
Dementia is a term used to describe a set of symptoms linked to different diseases of the brain.

(a) Use information from the box to complete the passage about dementia. **(5)**

45	heart disease	Parkinson's	forgetfulness	35
schizophrenia	poor eyesight	65	muscle tremors	stroke
	Alzheimer's	confusion	dizziness	

One disease associated with dementia is ..... . It is most common
in people over the age of ..... . Vascular dementia is another type
of dementia that can be caused by ..... . The symptoms shown
in people affected by vascular dementia include ..... and ..... .

(b) The diagram shows the number of people with dementia in some parts of the UK.



(i) Describe the distribution of dementia in the UK.

Use the diagram to help you with your answer.

(2)

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(ii) The total number of people with dementia in the UK is 800 000. The ratio of females to males with dementia is 3 : 2.

Calculate the number of males with dementia in the UK.

(2)

number of males with dementia = ...

(iii) Suggest why the number of cases of dementia is predicted to double by 2050.

(2)

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(Total for question = 11 marks)

Q4.

The table shows the hearing range of different species of animal.

Species	Lowest frequency hearing / Hz	Highest frequency hearing / Hz
dog	50	46 000
cat	30	50 000
human	20	20 000
frog	100	3000
mouse	1000	100 000

(a) Identify the species with the greatest hearing range.

(1)

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(b) Describe a method to investigate the frequency range audible to humans.

(3)

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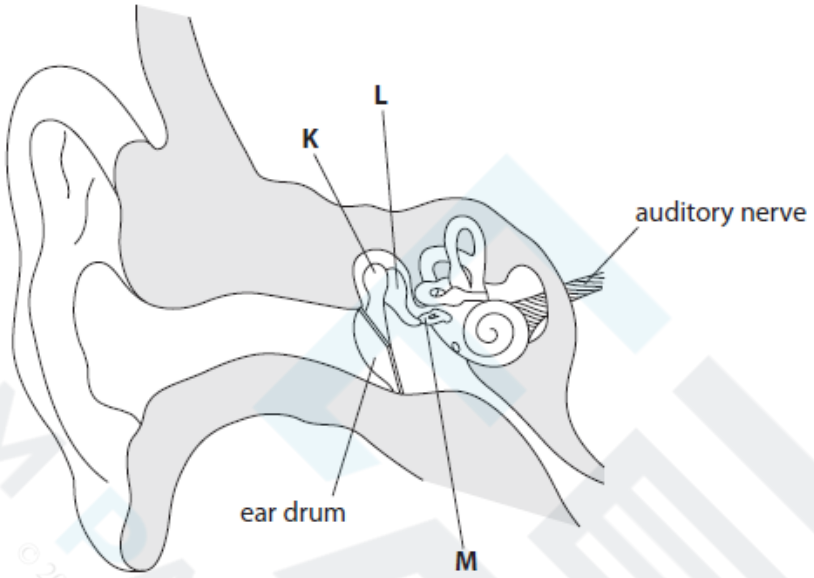
(c) The diagram shows a human ear.



(i) Name structures **K**, **L** and **M**.

(3)

A .....

B .....

C .....

(ii) Describe the role of structures **K**, **L** and **M** in hearing.

(2)

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.....

(d) The auditory nerve contains sensory neurones.
Draw a diagram of a sensory neurone in the space below.
Add the following labels to the diagram:

- axon
- cell body
- dendron
- myelin sheath.

(5)

(e) Explain how damage to the auditory nerve might affect hearing.

(3)

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(Total for question = 17 marks)

Q5.
The volume of alcohol in alcoholic drinks can be measured in units.
One unit is equivalent to 10 cm3 of pure alcohol.
The diagram shows a bottle of wine with 14% alcohol content and a glass containing 250 cm3 of this wine.

250 cm^3 glass of Ruby Red wine

(a) Calculate the number of units of alcohol in the glass of wine.

(2)

number of units = ...

(b) It is illegal for a person to drive a motor vehicle if they have more than the legal limit of alcohol in their bloodstream.
It takes one hour for the body to process one unit of alcohol so that there is no alcohol left in the bloodstream.
(i) A person drinks three units of alcohol. This puts her at the legal limit.
Calculate the time it would take before a person can legally drive after drinking four glasses of Ruby Red wine.

(2)

Answer ..... hours

(ii) Suggest why it is illegal for people to drive a motor vehicle with more than the legal limit of alcohol in their bloodstream.

(2)

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(c) Drinking a lot of alcohol over a long period of time can cause a condition called cirrhosis.

This condition prevents the cells of the liver from functioning normally.

Explain the effect of cirrhosis on the digestion of food molecules. **(5)**

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(Total for question = 11 marks)

Q6.
Aspirin is the active ingredient used in some tablets to relieve pain.
Aspirin becomes acidic when it dissolves in the body. The faster aspirin dissolves, the faster it can relieve pain.
A student investigates if it is better to mix sucrose or starch with the active ingredient to make an aspirin tablet.
This is the student's method.

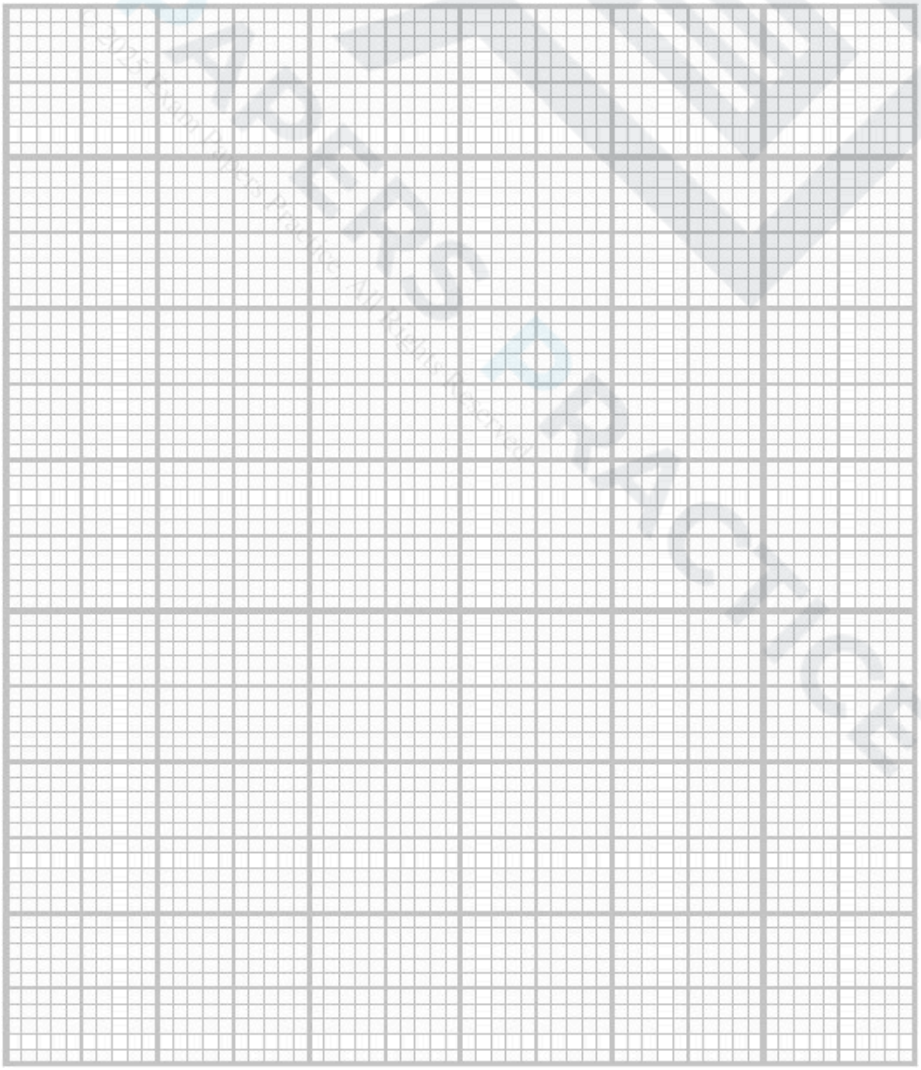
- add distilled water to three beakers, A, B and C
- add 1 aspirin tablet to each beaker
- add 5 g of sucrose to beaker B
- add 5 g of starch to beaker C
- measure the pH of the contents of each beaker at the start of the investigation
- measure the pH of the contents of each beaker every minute for 5 minutes

The table shows the student's results.

Beaker	pH of contents of beaker					
	at start	1 minute	2 minutes	3 minutes	4 minutes	5 minutes
A – aspirin	7.6	7.1	6.6	6.2	5.8	5.4
B – aspirin and sucrose	7.2	6.7	6.3	5.7	5.2	4.7
C – aspirin and starch	7.1	7.2	7.3	7.3	7.4	7.4

(a) (i) Plot a graph of the student's results.

Join the points with straight lines. **(5)**



(ii) State two variables that should be controlled in this investigation.

(2)

1 .....

2 .....

(iii) Name the dependent variable in this investigation.

(1)

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(b) Explain how the results of this investigation could help a manufacturer improve the effectiveness of its aspirin tablets.

(3)

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(Total for question = 11 marks)

Q7.

Answer the questions with a cross in the boxes you think are correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow. Obesity and diabetes have been linked to a 20% increase in the number of leg and foot
amputations.
Data from Diabetes UK shows that there were 26 378 lower limb amputations related to diabetes from the period 2014 to 2017. This is an increase from the period 2010 to 2013 when there were 22 092 amputations related to diabetes.

Minor lower limb amputations are below the ankle and major lower limb amputations are below

the knee. Minor lower limb amputations increased by 26.5% and major lower limb amputations increased by 4.0%.
In 2019 in the United Kingdom 3.8 million people had been diagnosed with diabetes and 90% of these people had Type 2 diabetes.
(a) (i) Describe the causes of obesity.

(3)

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(ii) Give two health risks, other than diabetes, associated with obesity.

(2)

1 .....

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2 .....

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(b) Diabetes is caused as a result of insulin not being secreted or not working correctly. (i)

Which organ secretes insulin?

(1)

☒ **A** kidney

☒ **B** liver

☒ **C** pancreas

☒ **D** thyroid

(ii) Insulin stimulates the conversion of glucose into glycogen.

In which organ does this occur?

(1)

☒ **A** kidney

☒ **B** Liver

☒ **C** pancreas

☒ **D** thyroid

(c) (i) Calculate the percentage increase in the number of lower limb amputations between the period 2010 to 2013 and the period 2014 to 2017.

(3)

percentage increase = ... %

(ii) Calculate the number of people in 2019 who had been diagnosed with Type 2 diabetes in the United Kingdom.

(1)

number of people = ... million

(d) Diabetes causes a narrowing of the arteries supplying blood to the lower limbs.

Suggest why this can lead to the need to amputate the lower limbs.

(3)

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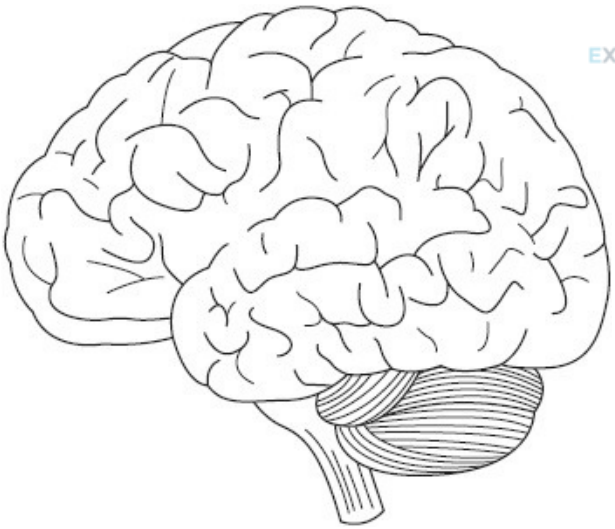
(Total for question = 14 marks)

Q8.

(a) The diagram shows a human brain.



Add lines labelled X, Y and Z to the diagram to show the areas of the brain that control these functions.

(3)

X voluntary actions
Y balance
Z breathing rate

(b) Parkinson's disease affects the cells in the brain that help to control body movement. The affected cells are unable to communicate effectively with neurones that cause muscles to contract.

(i) Name the type of neurone that causes muscles to contract.

(1)

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(ii) Give one difference between neurones that cause muscles to contract and

neurones that transmit nerve impulses from receptor organs.

(1)

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(iii) Explain how one neurone communicates with another neurone.

(3)

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(c) Recent scientific research into the treatment of Parkinson's disease has involved the use of stem cells. Explain how stem cells could be used to reduce the symptoms of Parkinson's disease.

(3)

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(Total for question = 11 marks)

Q9.

Answer the questions with a cross in the boxes you think are correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Sweating is normal when we are hot. It is part of our natural cooling mechanism. If you sweat visibly when you do not need to cool down, it can be a problem.

The sweating process is controlled by the brain, which sends signals down the nerves to the sweat glands.

Sweating is crucial to survival. We sweat to control body temperature and the sweat glands in our armpits can produce several litres of sweat in 24 hours. How much we sweat varies hugely from individual to individual and even from day to day.

Hyperhidrosis occurs when some areas of the body start sweating excessively. This affects about 1% of the population. There are two main types. The most common type is primary focal hyperhidrosis, which affects many parts of the body. There is no known cause, but it usually begins in childhood and often runs in families. Another type is secondary hyperhidrosis, which often doesn't begin until after the teenage years, and usually has an underlying medical cause. These causes can include diabetes, menopause or chronic infection. It can also be a result of eating certain foods. Stress can play a major role too.

(a) Which part of the brain controls sweating (line 4)?

(1)

☒ **A** cerebellum

☒ **B** cerebral hemispheres

☒ **C** hypothalamus

☒ **D** pituitary gland

(b) Which type of nerve sends signals to the sweat glands (lines 4 and 5)?

(1)

☒ **A** connector

☒ **B** motor

☒ **C** relay

☒ **D** sensory

(c) Describe how sweating controls body temperature (lines 6 and 7).

(3)

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(d) Explain the evidence in the passage that indicates primary focal hyperhidrosis is a genetic condition.

(3)

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(e) Secondary hyperhidrosis can be caused by diabetes. Give one risk factor for diabetes (line 16).

(1)

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(f) The passage states that how much we sweat varies from individual to individual and from day to day. Explain why this is the case in people without hyperhidrosis (lines 8 and 9).

(5)

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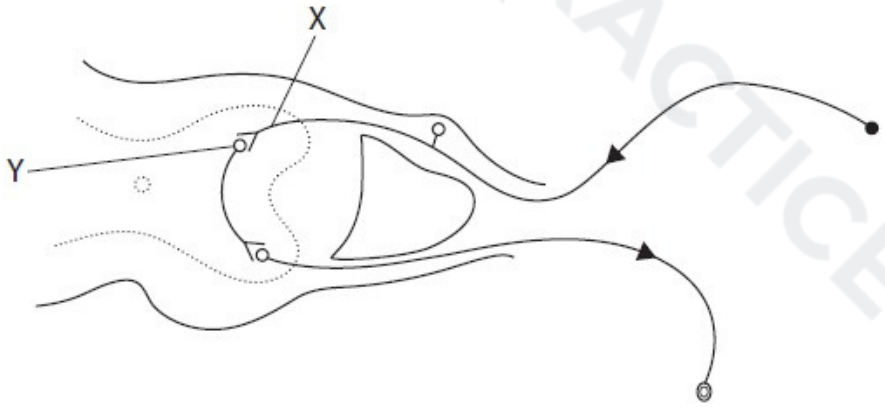
(Total for question = 14 marks)

Q10.

The diagram shows a reflex arc involved in a reflex action.



(a) Describe the function of a reflex action.

(3)

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(b) Using a line labelled Z, show on the diagram which part of the reflex arc would be connected to a receptor.

(1)

(c) Describe how the nerve impulse passes from position X to position Y in the reflex arc.

(6)

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(Total for question = 10 marks)

Q11.

This question is about the nervous system.

(a) Describe what is meant by a reflex action.

(3)

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(b) Diagram 1 shows a reflex arc.

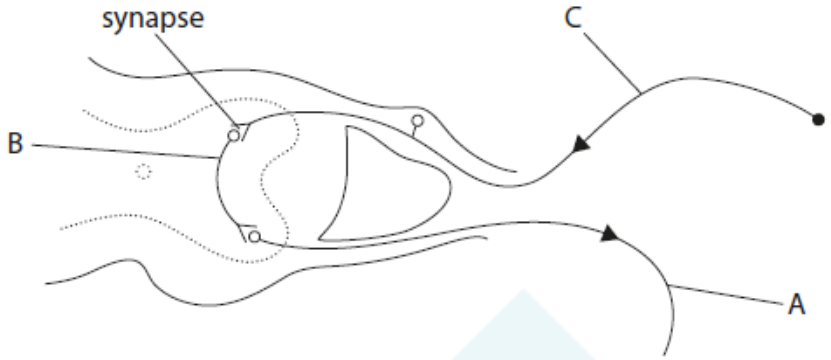

Diagram 1

Name the types of neurone labelled A, B and C.

(3)

A ..... B
..... C
..... (c)

Diagram 2 shows a neurone from a healthy brain and a neurone from the brain of someone with Alzheimer's disease.

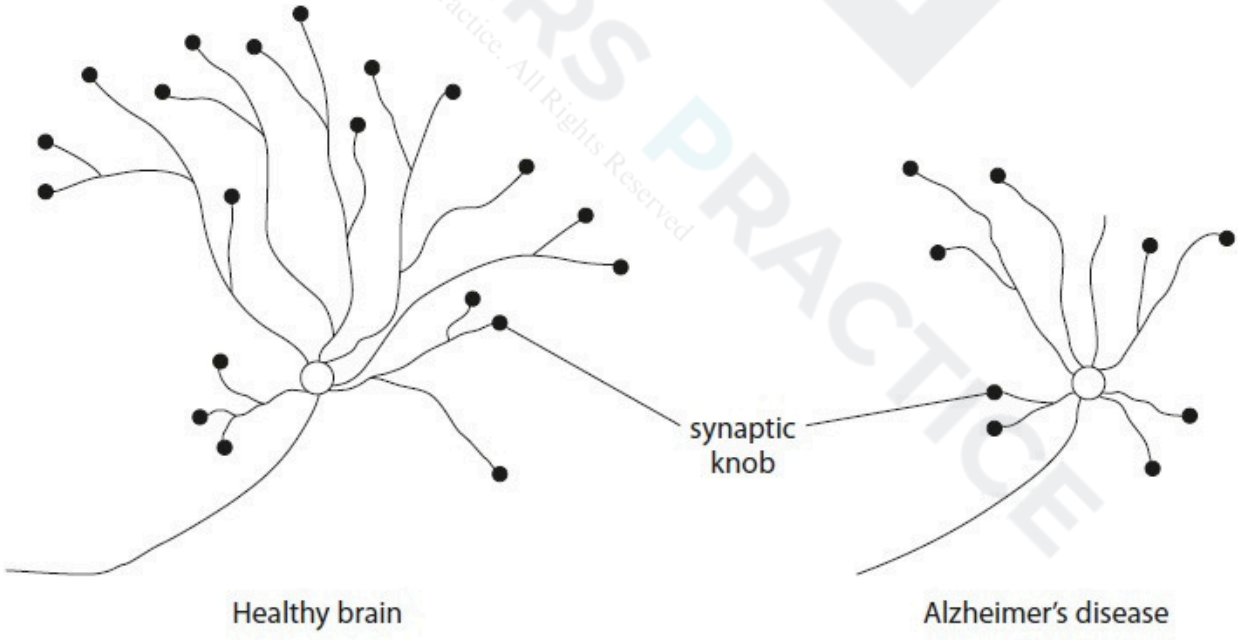

Diagram 2

(i) Give three differences between the two neurones.

(3)

1 .....

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2 .....

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3 .....

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(ii) Acetylcholine is a neurotransmitter. Explain the importance of acetylcholine in the functioning of the brain.

(3)

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..... (iii)

One symptom of Alzheimer's disease is that less acetylcholine is produced in the brain. Explain why there is less acetylcholine produced in people with Alzheimer's disease. Use information from diagram 2 to help your answer.

(3)

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(Total for question = 15 marks)

Q12.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The human eye consists of many parts.

(a) Which part has the highest concentration of light sensitive cells?

(1)

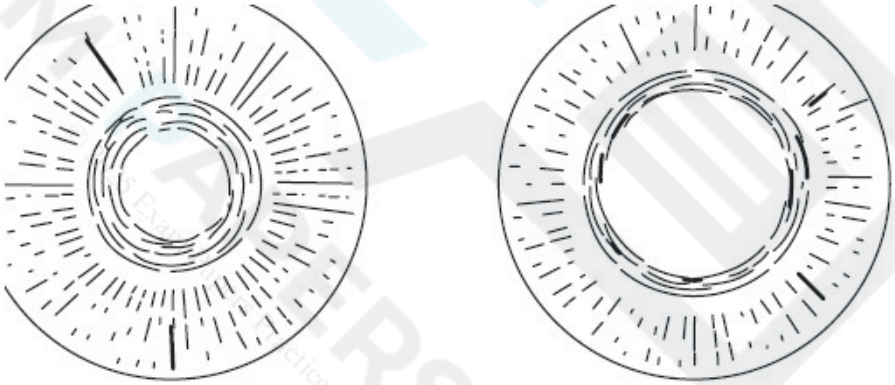
☒ **A** blind spot

☒ **B** choroid

☒ **C** fovea

☒ **D** optic nerve

(b) The diagram shows the iris of an eye in two different light conditions, A and B.



light condition A

light condition B

(i) Describe what happens in the eye when the light condition changes from A to B.

(5)

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(ii) Explain why it is important that the changes in the eye occur quickly when the light condition changes from

B to A.

(3)

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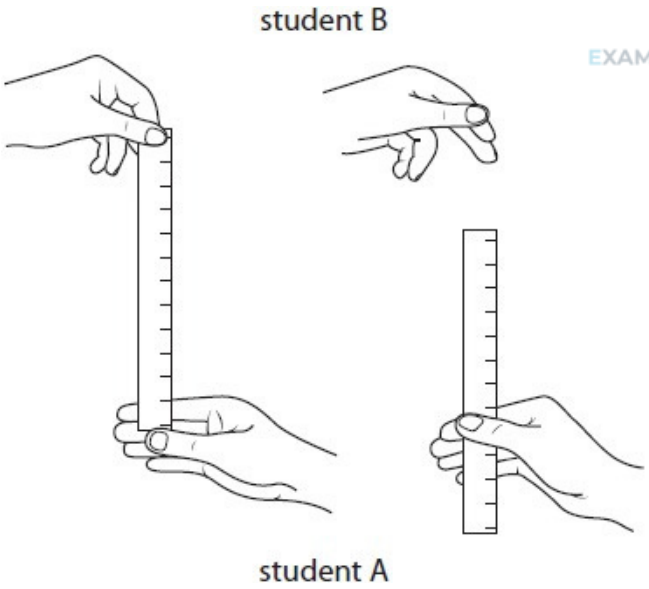
(Total for question = 9 marks)

Q13.

Two students use this method to investigate if caffeine affects the speed of a reflex action.

- student A sits in a chair holding out a hand with their thumb and forefinger open
- student B holds a metre rule with the 0 mm mark just above the open thumb and forefinger of student A
- student B releases the ruler
- student A catches the ruler as quickly as possible by closing their thumb and forefinger



The method is repeated 10 times.

The student catching the ruler now drinks a cup of coffee and waits for 30 minutes.

The investigation is then repeated.

The table shows the student's results.

	Distance travelled by ruler in mm										
Trial / Conditions	1	2	3	4	5	6	7	8	9	10	mean
without coffee	210	190	200	205	207	195	198	195	199	201	200
with coffee	165	160	163	167	165	170	175	170	180	175	

(a) Complete the table by calculating the missing mean value.

(2)

(b) Coffee contains caffeine.

State the effect of caffeine on the reflex action.

(1)

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(c) Explain why the student waited 30 minutes after drinking the coffee before continuing with the investigation.

(3)

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(d) The student who catches the ruler does not eat or drink anything for several hours before the investigation.
Suggest why this improves the validity of the investigation.

(2)

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(e) A cup of coffee contains 100 mg of caffeine. A can of cola contains 50 mg of caffeine.
If the student catching the ruler had drunk a can of cola instead of coffee, estimate the mean distance travelled by the ruler.

(1)

mean distance = ... mm

(Total for question = 9 marks)

Q14.
Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

The effects of alcohol

Humans have been drinking alcohol for thousands of years. Drinking too much alcohol over many years can cause diabetes, malnutrition and diseases of the central nervous system and the liver. One immediate side effect of drinking too much alcohol is increased urination.

Beer is about 95% water and only 5% alcohol. The liver converts that 5% of alcohol into the same volume of water and some carbon dioxide. So if a person drinks 200 cm^3 of beer (one unit), the end result is 200 cm^3 of water. However, this person will not just urinate 200 cm^3 of urine, in fact the person urinates a total of 320 cm^3 of urine. So in general each unit of alcohol makes the person urinate an extra 120 cm^3 of urine more than the normal urine output.

A person with a mass of 60 kg produces 60 cm^3 of urine an hour and a person with a mass of 80 kg produces 80 cm^3 an hour and so on. Therefore if a 60 kg person drinks 200 cm^3 of beer in an hour they will produce 60 cm^3 of urine plus 320 cm^3, making a total of 380 cm^3.

Alcohol interferes with the mechanism that regulates water levels in our body because alcohol affects a small gland called the pituitary gland. One hormone released by the pituitary gland is anti-diuretic hormone (ADH). Alcohol reduces how much ADH is released by the pituitary. Each unit of alcohol that a person drinks forces the kidneys to produce an extra 120 cm^3 of urine more than the normal output.

Logic suggests that drinking lots of water would replace the 120 cm^3 of urine produced, but it is not that simple. The body only retains half the water that a person drinks. The other half leaves the body in urine, so the person will become dehydrated even if they drink lots of water.

(a) (i) Where in the body is the pituitary gland (line 16)? **(1)**

- ☒ **A** brain
- ☒ **B** kidney
- ☒ **C** liver
- ☒ **D** pancreas

(ii) Which system includes the pituitary gland (line 16)? **(1)**

- ☒ **A** digestive
- ☒ **B** endocrine
- ☒ **C** nervous
- ☒ **D** skeletal

(b) A person weighs 75 kg and drinks 400 cm3 of beer in an hour (lines 11–14).

(i) Calculate the volume of urine produced by the person in this hour.

(3)

volume of urine = ... cm3

(ii) Calculate the percentage increase in the volume of urine produced by this person in this hour.

(3)

percentage increase = ... %

(c) Describe the effect of ADH on the kidney (line 17).

(2)

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(d) Suggest the effects of dehydration on the blood after increased urination.

(2)

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(e) Explain why half of the extra water that the person drinks still leaves the body in the urine (lines 21–24).

(3)

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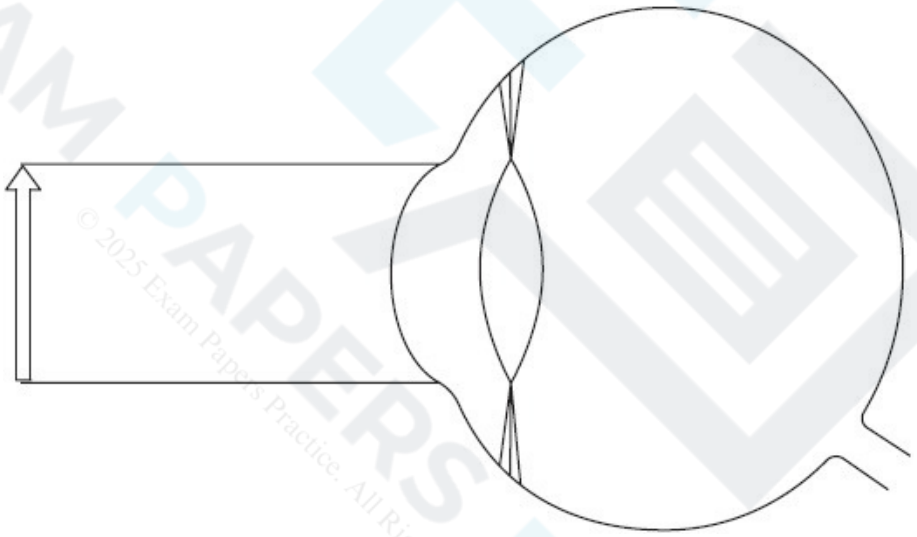
(Total for question = 15 marks)

Q15.

The diagram shows a section through the eye.

The arrow is a near object.



(a) (i) Complete the diagram by continuing the rays from the arrow to show how the image of the arrow appears on the retina.

(5)

(ii) Describe the function of the optic nerve in allowing a person to see the image of the arrow.

(2)

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..... (b) (i) State where the image of the arrow would be formed for someone with the condition of long sight.

(1)

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(ii) Give a feature of the eye that can lead to long sight. **(1)**

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.....

(iii) Describe a method of treating long sight.

(2)

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(c) Corneal transplants can be used to treat eye defects. Suggest two risks associated with corneal transplants.

(2)

1 .....

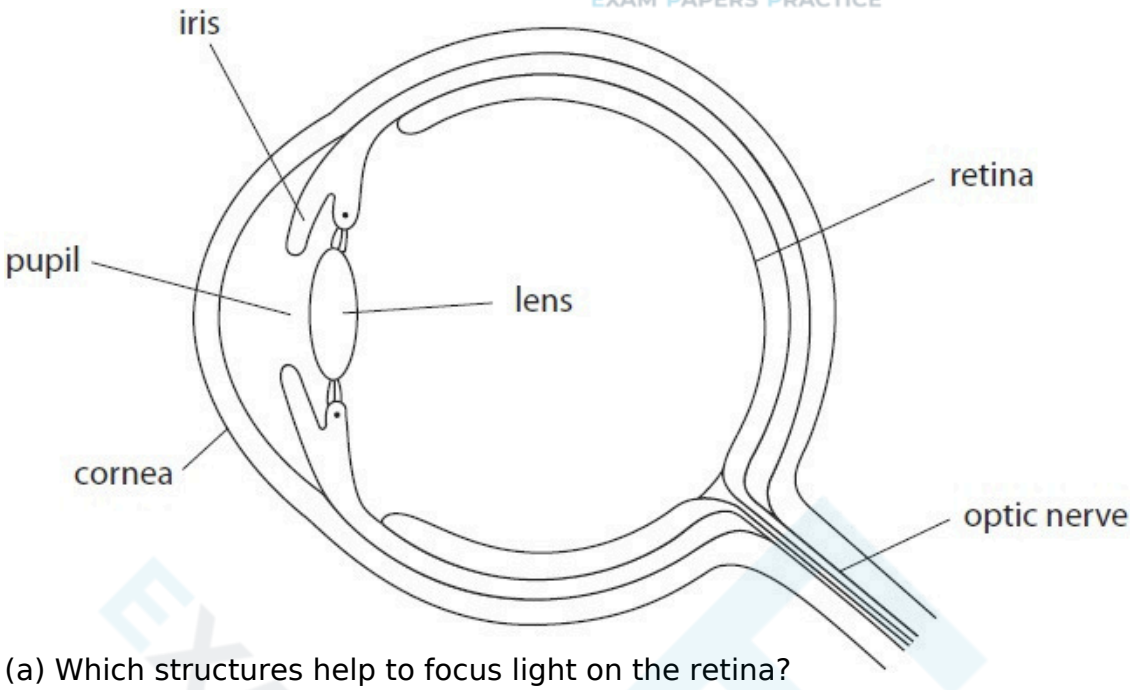
2 .....

(Total for question = 13 marks)

Q16.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The human eye contains structures that help to focus light on the retina.



(a) Which structures help to focus light on the retina?

(1)

☒ **A** cornea and lens

☒ **B** iris and cornea

☒ **C** iris and pupil

☒ **D** pupil and lens

(b) The intensity of light entering the eye can be measured in a unit called lux.

The table shows the results of an investigation on how light intensity affects the diameter of the pupil in the eye.

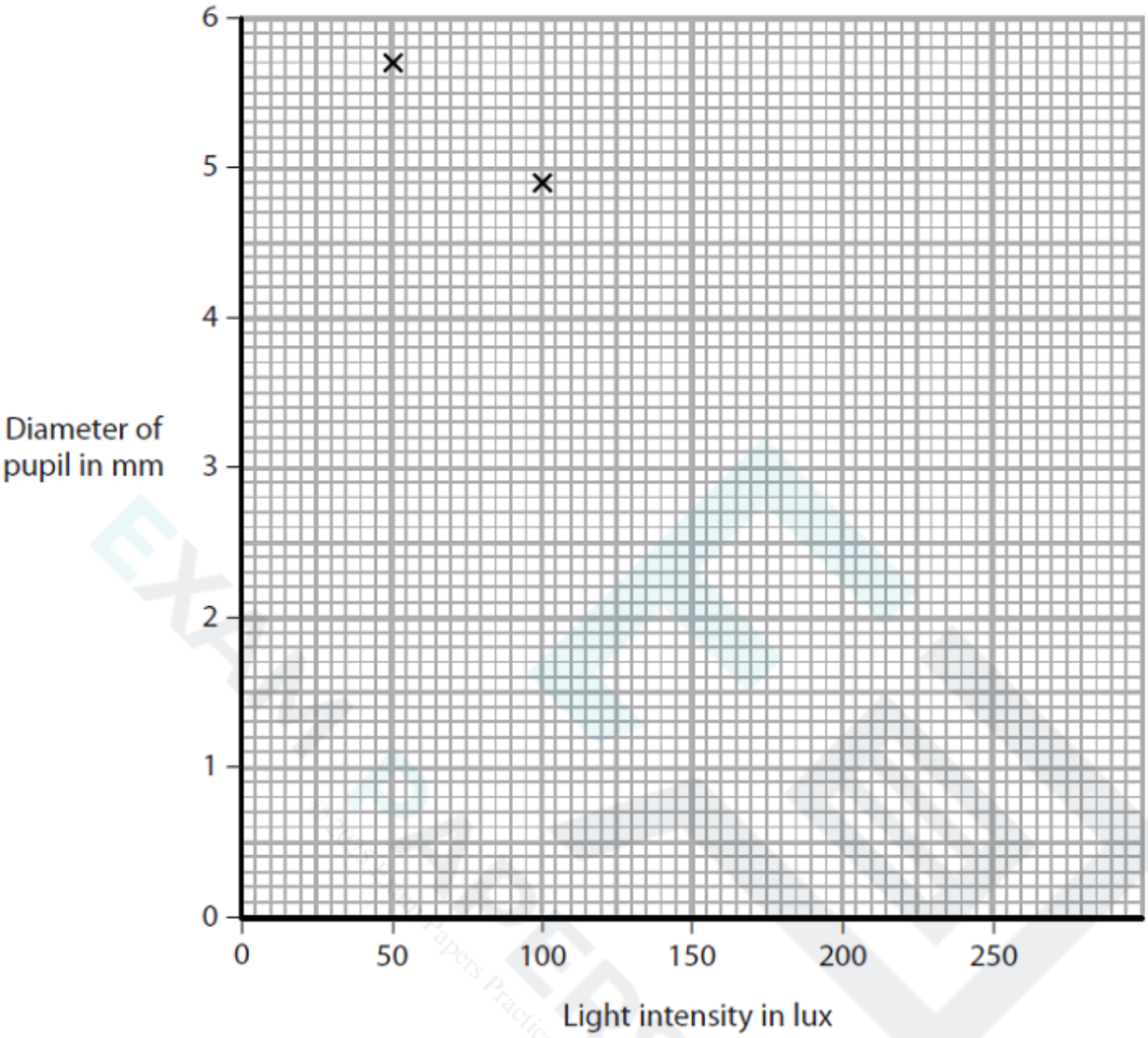
Light intensity in lux	Diameter of pupil in mm
50	5.7
100	4.9
150	2.7
200	3.2
250	2.3

(i) Complete the graph by plotting the results for 150, 200 and 250 lux.

(1)

(ii) Draw a straight line of best fit.

(1)



(iii) Explain which result is anomalous.

(2)

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(iv) State the effect of light intensity on the diameter of the pupil.

(1)

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(c) Short-sightedness is a common eye condition. Explain how short-sightedness affects vision.

(2)

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(Total for question = 8 marks)

Q17.

Skin and hair contain a pigment called melanin.

(a) (i) Describe the function of the pigment melanin in the skin.

(2)

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(ii) State one other place, apart from hair and skin, where pigment is found in the body.

(1)

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(b) A condition known as white forelock is caused by a dominant allele H.

People with this condition have a white patch in their hair.

The condition causes a deficiency of the skin pigment melanin.
A woman who is heterozygous for white forelock produces children with a father who does not have the condition.
(i) Draw a genetic diagram to show the possible offspring from this cross.
The condition is not sex-linked.

(4)

(ii) Calculate the probability that these parents will produce a boy with the condition.

(3)

probability = ...

(c) White forelock is a result of a mutation in a molecule of DNA. **(4)**

Describe how this mutation causes the white forelock phenotype.

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(Total for question = 14 marks)

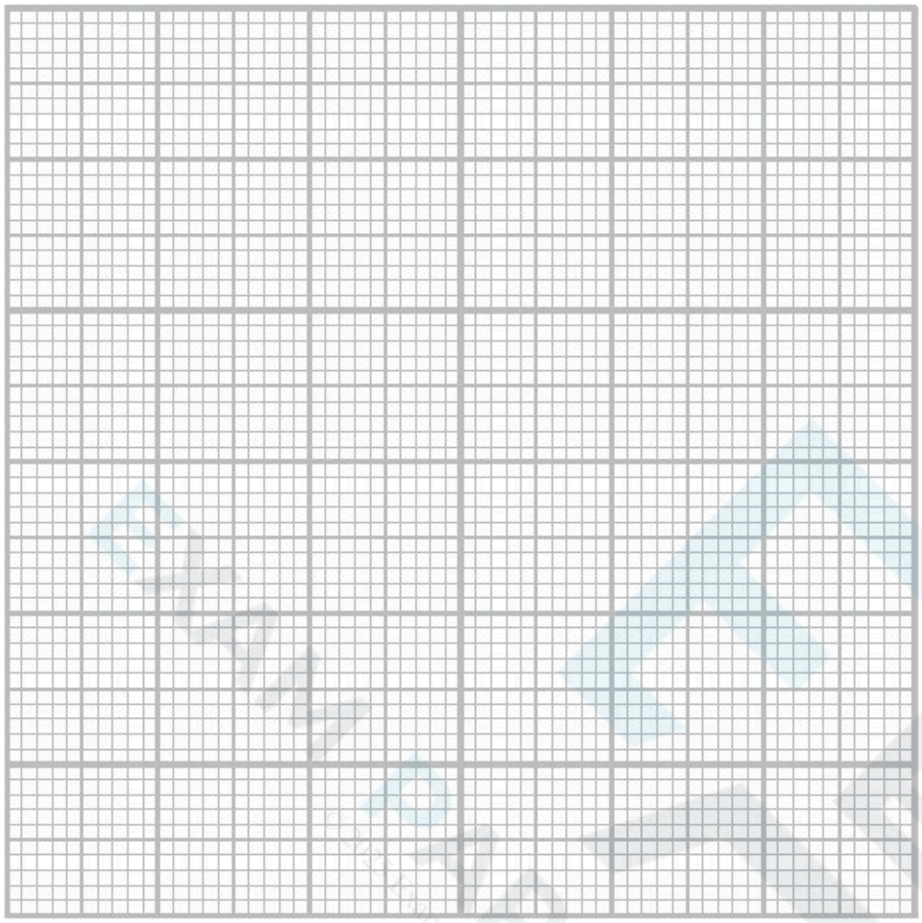
Q18.
A scientist investigates how the drug, atropine, affects the heart rate in humans.
Atropine paralyses the vagus nerve which carries impulses from the brain to the heart.
The heart rates of ten people are measured at intervals of two minutes for eight minutes, after which, atropine is injected.
The scientist continues to measure the heart rates.
The scientist's results are shown in the table.

Time in minutes	Heart rate in beats per minute
0	90
2	81
4	78
6	80
8	82
9	100
10	120
11	148
12	160
13	138
15	128
17	120
19	116
21	109
23	100

atropine injected →

(a) (i) Plot the scientist's results on the grid. Draw a curve of best fit.

(6)



(ii) Explain why ten people are injected with atropine rather than just one person.

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..... **(2)**

(b) (i) Calculate the percentage change in the heart rate at 12 minutes compared to the heart rate at the start of

the investigation.

(2)

percentage change = ... %

(ii) Explain why this percentage change is not achieved as soon as atropine is injected.

(2)

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(c) Suggest the function of the vagus nerve.

(2)

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(Total for question = 14 marks)