

## Grey Matter -4

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Date: \_\_\_\_\_

Time:

Total Marks Available:

Total Marks Archived:

Level: Edexcel A level Biology

Subject: Biology

Exam Board: Pearson Edexcel Level 3 GCE AS and A level Biology A (Salters-Nuffield) and also Pearsons Edexcel AS and A Level Biology B (9BI0) - Is however suitable for use by AS and A level Biology Students of other Boards

Topic: Grey Matter -4

Type: Topic Questions

To be used by all students preparing for Edexcel AS and A level Biology A and Biology B - Students of other Boards may also find this useful

## Questions

Q1.

The scientific article you have studied is from *Scientific American*.

Use the information from the scientific article and your own knowledge to answer the following question.

Sight is a sense that develops during a critical period, 'providing a basis on which the brain can compute the activity needed for self-preservation.' (paragraph 22).

Describe what is meant by a critical period.

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(Total for question = 2 marks)

Q2.

Nicotine is a drug found in the smoke of cigarettes.

The effect of inhaling nicotine on the circulatory system of rats was investigated. In this investigation, three variables were considered:

- the concentration of nicotine in blood plasma
- the diameter of the lumen of one artery
- blood pressure



Two groups of rats were treated as shown in the table.

Group	Number of rats in group	Nicotine dose / mg
A	6	1.0
B	6	0.1

(i) The concentration of nicotine in the blood plasma of the group A rats was recorded at different times and

the means calculated.

The means are shown in the table along with the range of data for each mean.

Time of sampling / minutes	Mean concentration of nicotine in blood plasma / $\text{ng cm}^{-3}$
0 (immediately after inhalation)	$35.0 \pm 9.3$
30 (after inhalation)	$24.1 \pm 5.6$

Determine the maximum rate of decrease in the concentration of nicotine in the blood plasma per minute after being given the nicotine.

(2)

Answer .....  $\text{ng cm}^{-3} \text{min}^{-1}$

(ii) The diameter of the lumen of one artery, in each of the 12 rats, was measured

when the rats were resting. The blood pressure of each rat was also measured and the mean blood pressure calculated.

The diameter of the lumen of the artery and the blood pressure of each rat were then recorded at intervals, for a total of 30 minutes. The rats inhaled nicotine for the first minute (0.0 to 1.0).



The table shows the results for the mean diameter of the lumen of the artery.

Time / minutes	Mean diameter of lumen / $\mu\text{m}$	
	Group A (1.0 mg nicotine)	Group B (0.1 mg nicotine)
0.0	48	48
0.5	44	44
1.0	49	45
2.0	52	48
5.0	57	52
10.0	55	48
15.0	49	48
30.0	49	48

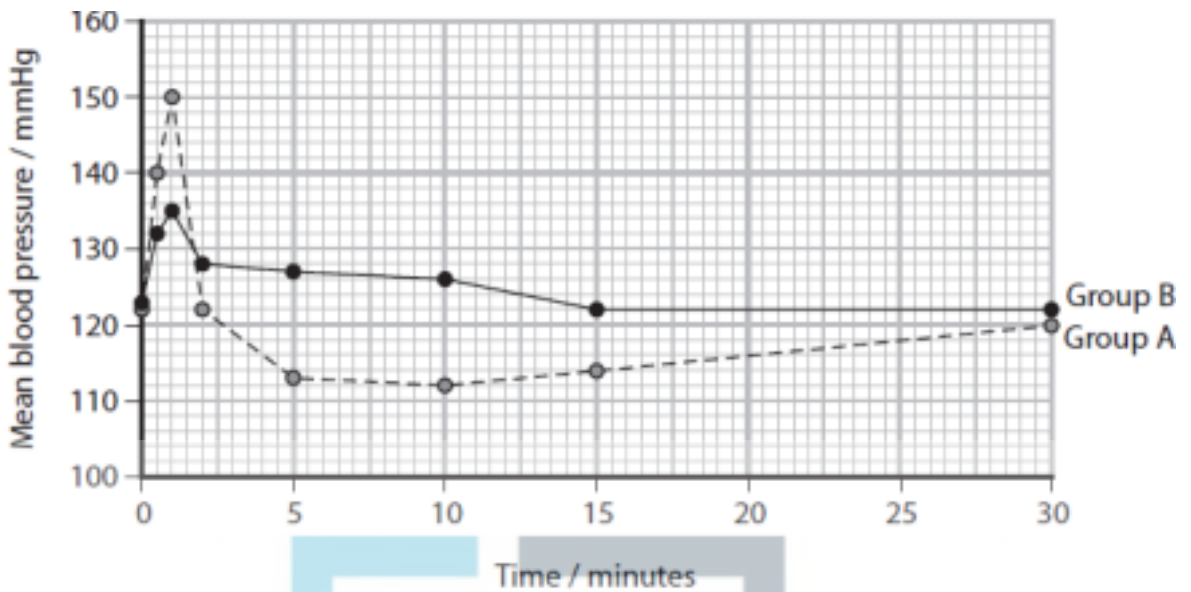
Determine the effect of nicotine concentration on the percentage change in lumen diameter in the first minute.

EXAM PAPERS PRACTICE

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\*(iii) The graph shows the results for the mean blood pressure for the two groups of rats. Nicotine was inhaled for the first minute.



It has been stated that:

'Nicotine gained from smoking cigarettes in humans causes an increase in blood pressure and a decrease in the lumen of arteries.'

Analyse all the data from this investigation using rats to evaluate the validity of this statement.

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(Total for question = 10 marks)

Q3.

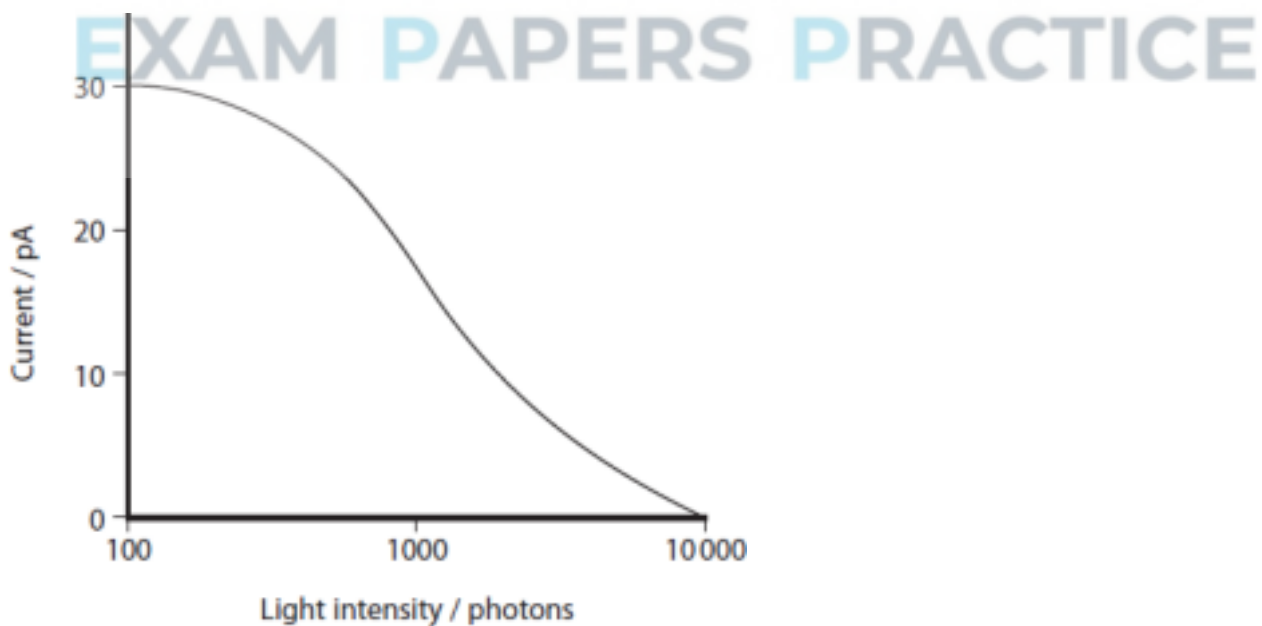
The retina of the human eye contains rod cells.

These cells detect light energy as photons.

The light energy is converted to a nerve impulse that is interpreted by the brain.

A current is produced by a rod cell when ions move through the cell surface membrane of a rod cell.

The graph shows the effect of increasing light intensity on the current produced by a rod cell.



Explain the effect of increasing light intensity on the current produced by a rod cell.

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(Total for question = 5 marks)

Q4.

The neurones of the central nervous system contain TAU proteins. These proteins help to maintain cell structure.

In humans, six different TAU proteins can be produced from a single gene.

Parkinson's disease has been linked to the different forms of the TAU proteins present in neurones.

Scientists are studying the effect of these different TAU proteins in animal models. One model used is the fruit fly, *Drosophila*.

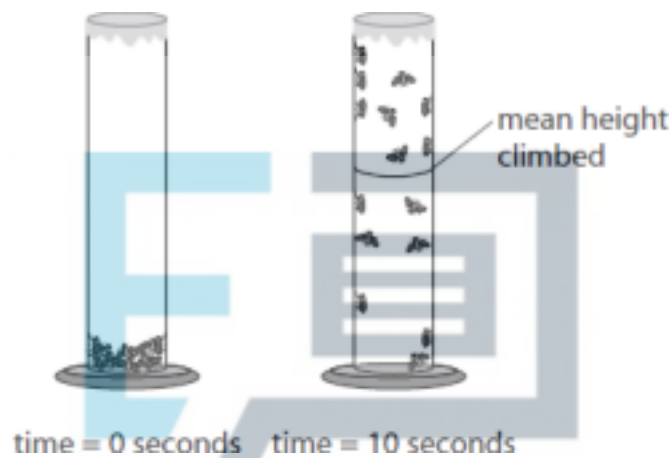
In one investigation, the effect of ageing on *Drosophila* making different human TAU proteins was studied.

Flies making different forms of human TAU protein were tested in a climbing test.



## EXAM PAPERS PRACTICE

- Fifteen one-day-old *Drosophila* flies were placed at the bottom of a measuring cylinder.
- A video recording was carried out and paused at 10 seconds. The height climbed by each fly was recorded.
- The test was repeated for flies of different ages.



The table shows the results of this investigation.

Age of flies / days	Mean height climbed at 10 seconds / mm		
	Control (no human TAU protein)	0N3R TAU protein	0N4R TAU protein
1	60 ± 6	52 ± 5	54 ± 5
7	61 ± 4	43 ± 1	50 ± 4
14	53 ± 3	18 ± 2	28 ± 8
21	45 ± 9	12 ± 4	18 ± 5
28	32 ± 8	10 ± 5	19 ± 1
35	26 ± 9	3 ± 1	11 ± 1
42	15 ± 3	1 ± 1	3 ± 1

Comment on the effect of TAU proteins on the ability of *Drosophila* flies to climb.

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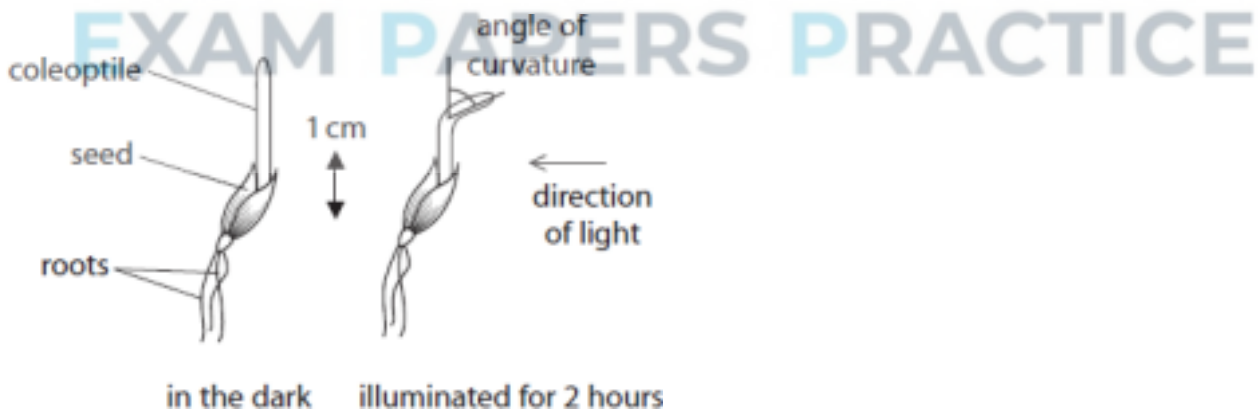
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Q5.

When oat seeds germinate, they produce roots and a coleoptile.

The effect of shading the tip of the coleoptile was investigated.

The diagram shows how the coleoptile of an oat seedling can bend towards light.

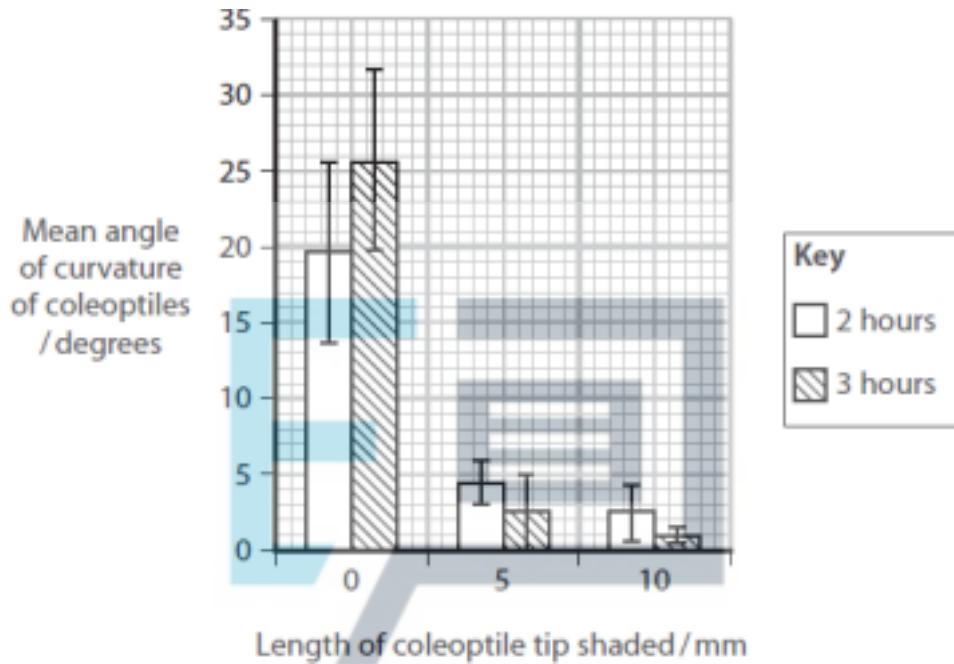


Oat seeds were germinated. When the coleoptiles were 2 cm long the seedlings were split into three groups.

- Group 1 none of the tip of the coleoptile was shaded
- Group 2 5 mm at the tip of the coleoptile was shaded
- Group 3 10 mm at the tip of the coleoptile was shaded

All the coleoptiles were then exposed to light from one side.

The curvature of the coleoptiles was measured after intervals of 2 hours and 3 hours. The results of this investigation are shown in the graph.



(i) Describe two conclusions that can be drawn from the results of this investigation.

EXAM PAPERS PRACTICE

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(ii) The results of this investigation were analysed using the Student's t-test. A p value of 0.05 was used to interpret the results of the t-test.

Explain what a p value of 0.05 means.

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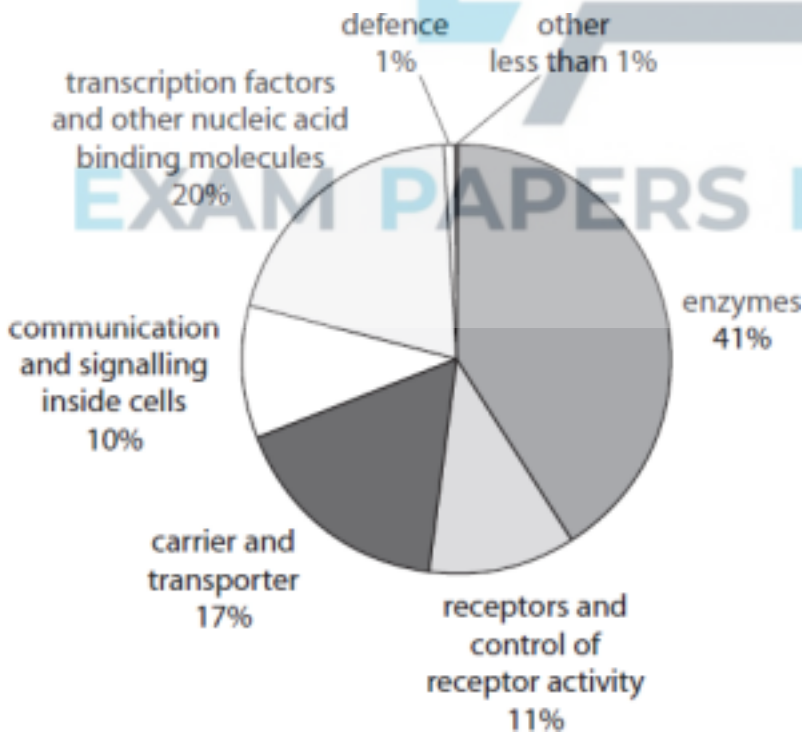
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(Total for question = 4 marks)

Q6.

\* The human genome codes for approximately 20 000 different proteins. The pie chart shows the proportion of proteins carrying out different functions.



The 20 amino acids used to make proteins can be classified according to the properties of their side chains (R groups).

Table 1 shows the number of amino acids with these properties.



Property of the side chain group	Number of amino acids with the property
Non-polar	9
Polar, uncharged	6
Negatively charged	3
Positively charged	2

Table 1

Table 2 shows three amino acids, used to synthesise proteins, that have unique properties.

Amino acid	Comment on structure
Cysteine	The side chain contains a thiol group (-S-H) that is chemically reactive.
Glycine	The side chain is a hydrogen atom which is much smaller than any other side chain. This allows tight coiling of polypeptide chains.
Proline	The side chain forms a peptide bond with the nitrogen in the amino group. This makes a polypeptide chain more rigid.

Table 2

Discuss the importance of the amino acid side chain to the structure, function and location of proteins.

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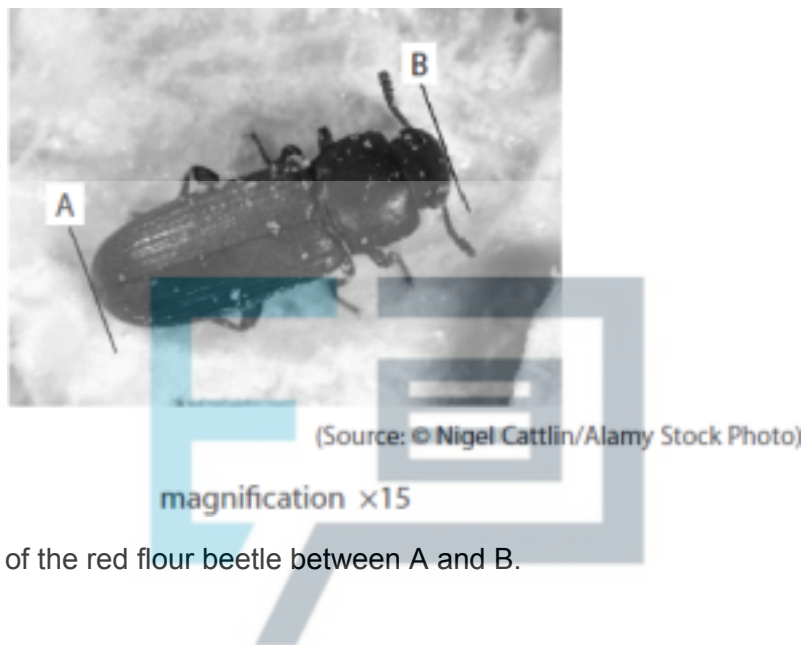
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Q7.

The red flour beetle (*Tribolium castaneum*) is a food pest found in flour.

The photograph shows a red flour beetle.



Calculate the length of the red flour beetle between A and B.

(1)

EXAM PAPERS PRACTICE ..... mm

(Total for question = 1 mark)

Q8.

The scientific article you have studied is from *Scientific American*.

Use the information from the scientific article and your own knowledge to answer the following question.

Describe how 'eyes relay visual information' to the brain (paragraph 2).

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EXAM PAPERS PRACTICE

(Total for question = 5 marks)

Q9.

Plants can respond to and use light.

The photograph shows a seedling starting to grow from a germinating seed.



Describe the role of IAA (auxin) in the phototropic response of plants.

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(Total for question = 4 marks)





(i) Explain why inhibitors of acetylcholinesterase could be useful in the treatment of Alzheimer's disease.

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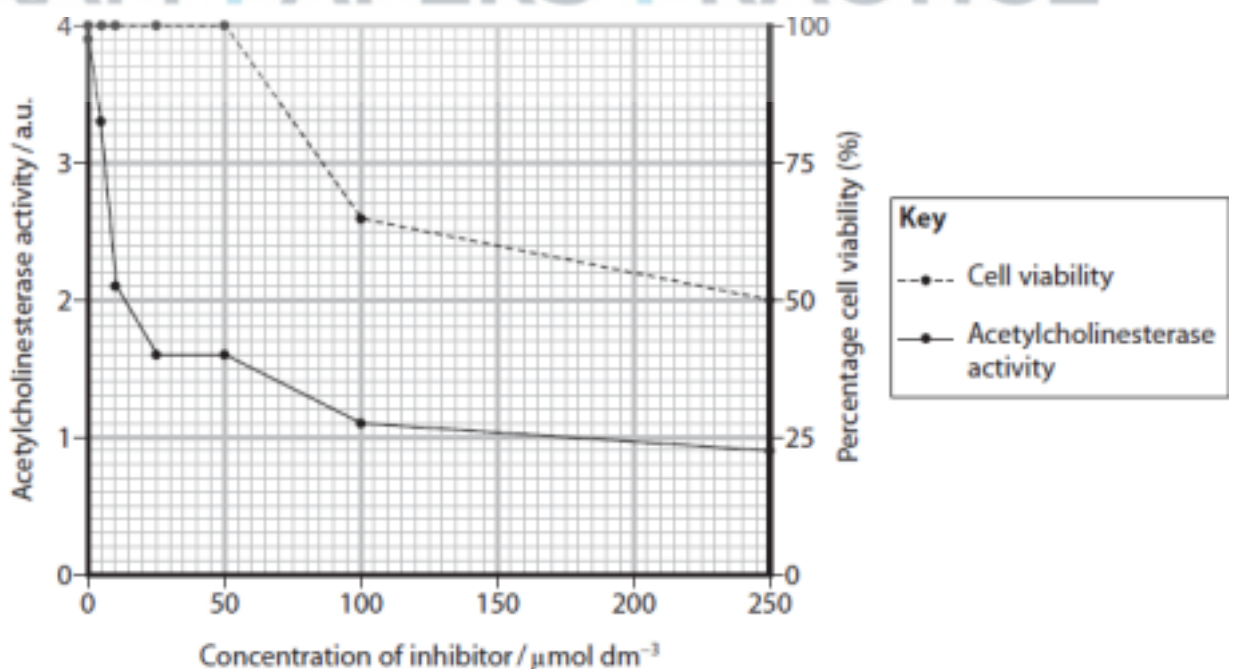
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(ii) Trials of a new inhibitor were carried out using tissue cultures.

The effect of the concentration of the inhibitor on acetylcholinesterase activity and cell viability was measured.

Percentage cell viability was measured as the percentage of cells that were not killed by the inhibitor.

The graph shows the results for this inhibitor.



State and justify a suitable concentration of inhibitor to use in clinical trials.

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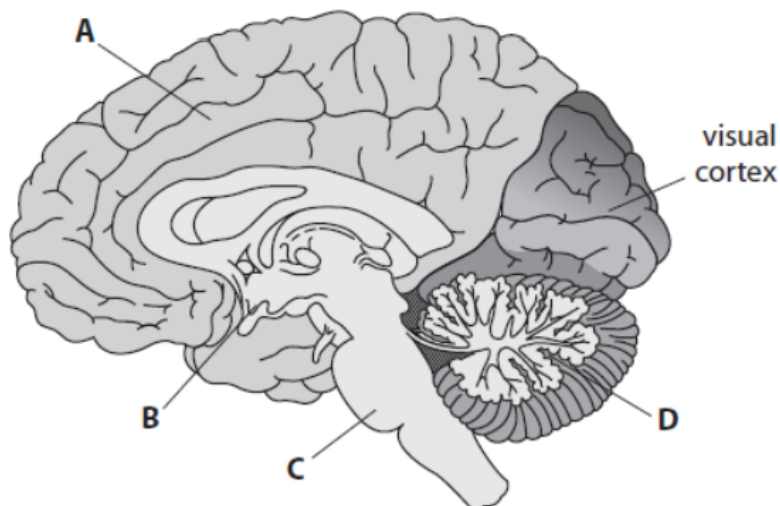
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(Total for question = 6 marks)

Q12.

Visual development requires exposure of the visual cortex to environmental signals during a critical period.

The diagram shows parts of the brain, including the visual cortex.



The visual cortex processes information received from the retina.

(i) The non-protein part of the light-absorbing pigment in the rod cells of the retina is called

(1)

- A IAA
- B opsin
- C retinal
- D rhodopsin

(ii) The part of the brain involved in interpreting the information processed in the visual cortex is

(1)

- A
- B
- C
- D

(iii) Explain how fMRI can be used to identify the part of the brain involved in interpreting information from the visual cortex.

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**(Total for question = 5 marks)**

Q13.

Glucosaminoglycans (GAGs) are the by-products of chemical reactions inside cells. GAGs are broken down by enzymes inside lysosomes in cells.

Mucopolysaccharidosis type I (MPS I) is a genetic condition that results in the build-up of GAGs inside cells.

MPS I affects the production of enzyme G that breaks down GAGs inside lysosomes.

More than 50 different mutations in the gene for enzyme G have been found to result in MPS I. Most of these mutations involve changing a single base in the gene.

A biotechnology company is developing a method of repairing the mutations in the gene for enzyme G.

The method being developed is called CRISPR-Cas9.

In this method, a short sequence of RNA binds to the DNA containing the mutation responsible for MPS I.

This RNA acts as a guide to enable the Cas9 enzyme to bind to DNA.

This enzyme can then cut and repair the DNA, removing the mutation.



(i) Describe how scientists could produce this short sequence of RNA needed to treat someone with MPS I.

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(ii) Explain why the use of CRISPR-Cas9 technology can be described as personalised medicine.

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**(Total for question = 4 marks)**



Q14.

An investigation was carried out to study the effect of positive and negative physical and emotional experiences on humans.

The positive physical experience was a warm object placed on the arm of a person for five seconds.

The negative physical experience was a hot object placed on the arm of a person for five seconds.

All other variables were kept constant.

Two groups of people were used in this investigation. In the first group, the warm object was used before the hot object. In the second group, the hot object was used before the warm object.

After each experience, the individuals were asked to rate their feelings using the scoring system below.

Feelings	Score
Very bad	1
Bad	2
Neutral	3
Good	4
Very good	5

Suggest why one group had the warm object placed on their arm before the hot object and the other group had the hot object placed on their arm first.



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Q15.

An investigation was carried out to study the effect of light on the mammalian retina.

Part of the retina of a young rat was removed and kept in the dark for two hours. This allowed the pigment in the rod cells to recover from bleaching caused by exposure to light.

Suggest what happens in the rod cells during this two hours of darkness.

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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 .

There are many reasons why humans may lose muscle mass.

Two known causes are hip replacement surgery and some genetically inherited conditions.

Muscles can be scanned using magnetic resonance imaging (MRI) to investigate the loss of muscle mass.

It is safer to use MRI than computed tomography (CT) because

(1)

- A CT uses X-rays that can cause mutations in the DNA of muscle fibres
- B CT uses X-rays that can cause mutations in the protein in the muscle fibres
- C CT uses magnets that can cause mutations in the DNA of muscle fibres
- D CT uses magnets that can cause mutations in the protein in the muscle fibres

(Total for question = 1 mark)