

## Grey Matter -1

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 -1

Type: Topic Question

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.

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

Describe the role of visual stimulation on the development of the visual cortex during the critical period.

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EXAM PAPERS PRACTICE

(Total for question = 3 marks)

Q2.

Voltage-gated  $K^+$  and  $Na^+$  channels are involved in the transmission of impulses in sensory and motor neurones.

Describe the differences in the structure of a myelinated sensory neurone and a myelinated motor neurone.

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Q3.

A person arrived at hospital having eaten some poisonous berries.

An electrocardiogram (ECG) was recorded for this person.

The poison also caused the pupils of this person to dilate.

Describe the interaction of the muscles in the eye that led to this dilation of the pupils.

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EXAM PAPERS PRACTICE

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**(Total for question = 3 marks)**



Q4.

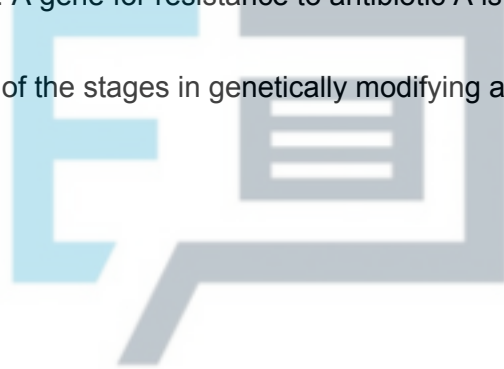
Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

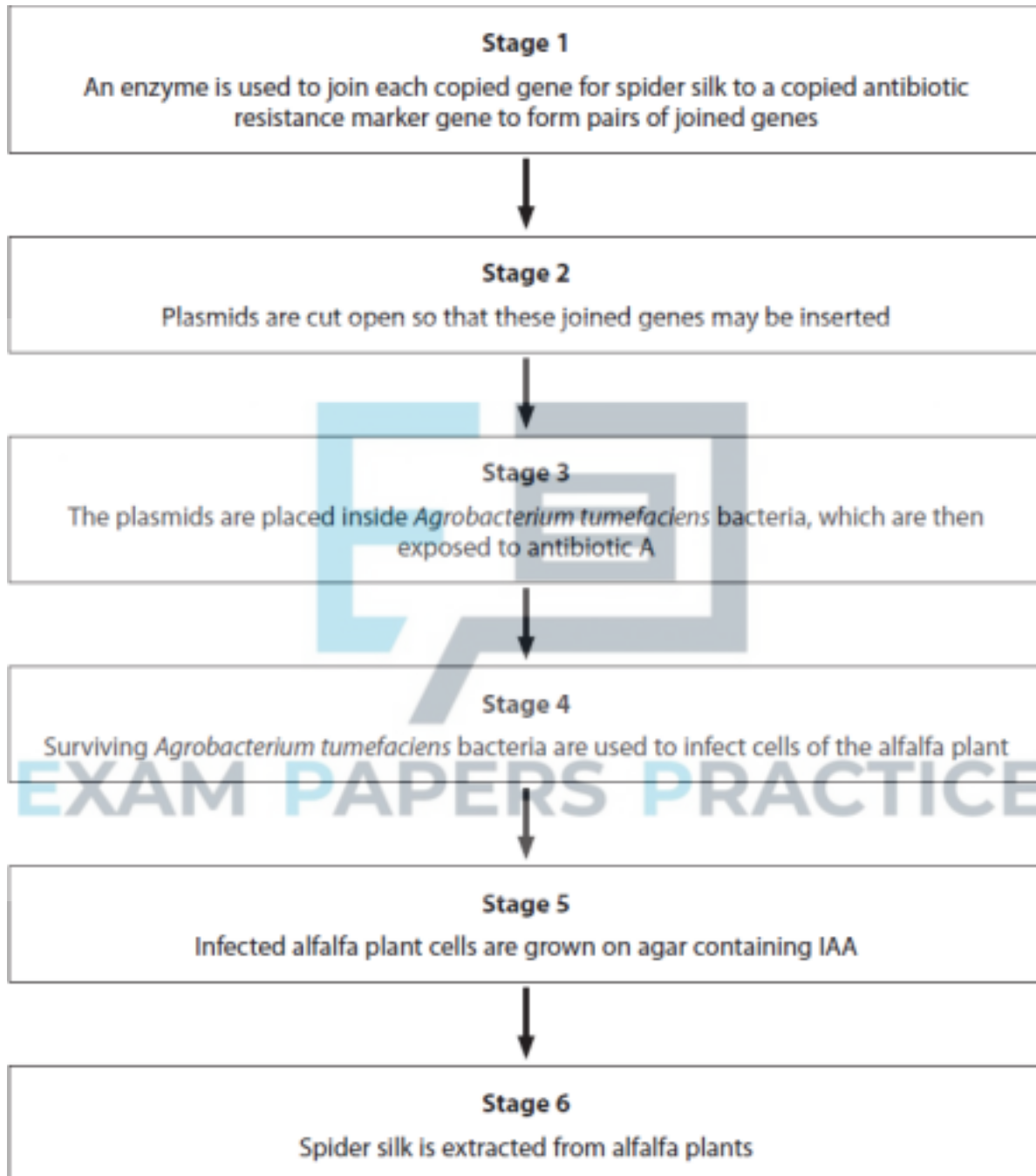
Spider silk is a very strong and flexible natural fibre. It is of interest to humans as a possible fibre for protective clothing.

Scientists have genetically modified a range of organisms to produce spider silk, including goats and plants such as alfalfa.

A gene for spider silk is copied. A gene for resistance to antibiotic A is also copied.

The flow diagram shows some of the stages in genetically modifying alfalfa plants to produce spider silk using the copied genes.





(i) Explain how an enzyme is involved in joining the two different genes together in stage 1.

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(ii) Which one of the following enzymes can be used to cut open the plasmids in stage 2?

(1)

- A DNA polymerase
- B RNA ligase
- C RNA polymerase
- D restriction endonuclease

(iii) Explain why antibiotic A is used in stage 3.

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EXAM PAPERS PRACTICE

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(iv) Give reasons why the infected alfalfa plant cells are grown on agar containing IAA in stage 5.

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(v) The table shows the mass of spider silk produced from the genetically modified alfalfa in stage 6. It also shows the mass of spider silk produced from the genetically modified goats.

Organism	Mass of spider silk produced per year
Alfalfa	218 kg per acre
Goat	10 kg per goat

A typical number of goats that can be kept on one acre of land is 12.

Calculate the percentage increase in spider silk produced by the alfalfa plants compared with the goats.

EXAM PAPERS PRACTICE (3)  
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**(Total for question = 11 marks)**

Q5.

Serotonin is found in the brain and is important in health and wellbeing.

An imbalance of serotonin can lead to problems such as depression. An individual with symptoms of depression may have low serotonin levels in the brain.

The use of drugs such as MDMA (ecstasy) can cause an imbalance of chemicals in the brain.



(i) Describe how the use of MDMA could affect the transmission of impulses in the brain.

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(ii) Individuals who use MDMA may develop the symptoms of depression.  
Explain how the use of MDMA could result in the development of these symptoms.

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EXAM PAPERS PRACTICE

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



Q6.

A study was carried out to investigate the effect of red light and far red light on the growth of flowers in a plant.

Plants were kept under two different light regimes, A and B. Regime A used red light and far red light at the same intensity. Regime B used red light and far red light but the red light was at a lower intensity. The intensity of the far red light was unchanged.

When the plants were fully grown, the dry mass of the flowers produced was measured. This study was repeated using a new group of plants.

The results for the original study and the repeat study are shown in the table.

Study	Mean dry mass of the flowers / g	
	Regime A	Regime B
Original	58	45
Repeat	43	38

(i) Calculate the percentage difference between the mean dry mass of flowers in regime A with that in regime B in the original study.

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Answer .....

(ii) Compare and contrast the results of regime A with regime B for both the original and repeat studies.

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(Total for question = 4 marks)

Q7.

The ability to grow long stems is important in woodland plants because longer stems increase the chance of the plant receiving light for photosynthesis.

Any plant in the shade of other plants will be exposed to more far red light than red light because other plants absorb most of the red light.

A student wrote the hypothesis:

*'The length of a plant stem depends on the amount of red light or far red light they receive'*. Design an investigation the student could use to test this hypothesis.

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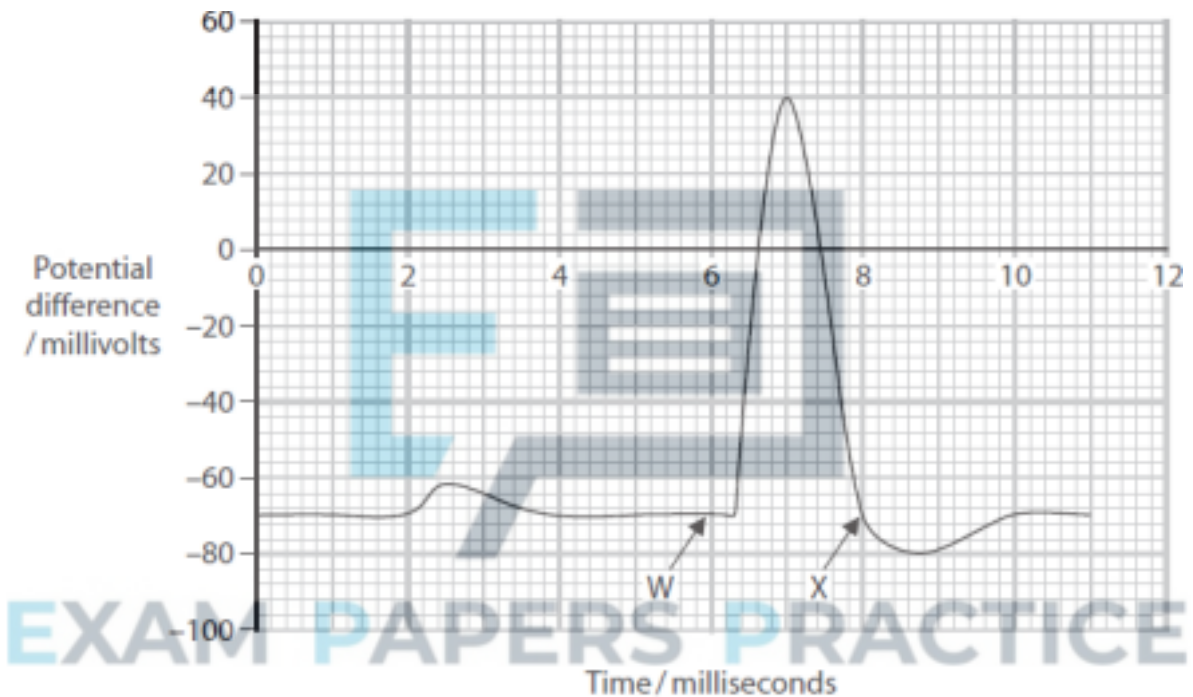
(Total for question = 4 marks)



Q8.

The nervous system is one of the features found only in animals.

The graph shows the change in potential difference across the cell surface membrane of a neurone when it is stimulated at point W.



(i) The threshold intensity is the minimum electrical stimulus that will cause a neurone to form an action potential.

Which potential difference could be the threshold potential for this neurone?

- A -80 millivolts
- B -70 millivolts
- C -60 millivolts
- D 40 millivolts

(ii) Explain the changes in the sodium and potassium ion concentrations in the cytoplasm of the neurone from point W to point X on the graph.

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(iii) Explain why the neurone becomes hyperpolarised after point X on the graph.

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Q9.

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.

The immune system plays a role in recovery following spinal cord injuries.

Give **two** ethical arguments to support the use of rats and mice with spinal cord injuries in these experiments (paragraph 10).

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EXAM PAPERS PRACTICE

(Total for question = 2 marks)

Q10.

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

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

Discuss the ethical issues relating to the use of mice in experiments such as those described in the article (paragraph 25).

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(Total for question = 4 marks)

Q11.

Some marine snails produce chemicals called conotoxins. These chemicals paralyse the prey of these snails by interfering with the conduction of nerve impulses to muscles.

Conotoxins can be modified to produce painkillers.

The effects of conotoxins on the nervous system were first demonstrated in experiments involving animals.

These experiments were involved in the development of painkillers from conotoxins.

(i) Describe the ethical issues concerning the use of animals in this research.

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(ii) After testing on animals, painkillers undergo three-phased testing.

In an investigation testing the effectiveness of a painkiller produced from conotoxin, the new painkiller was tested on a group of healthy volunteers.

Explain the reasons for this stage in the testing of the painkiller.

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Q12.

The modern bread wheat plant (*Triticum aestivum*) has been developed from other plant species that have different genomes.

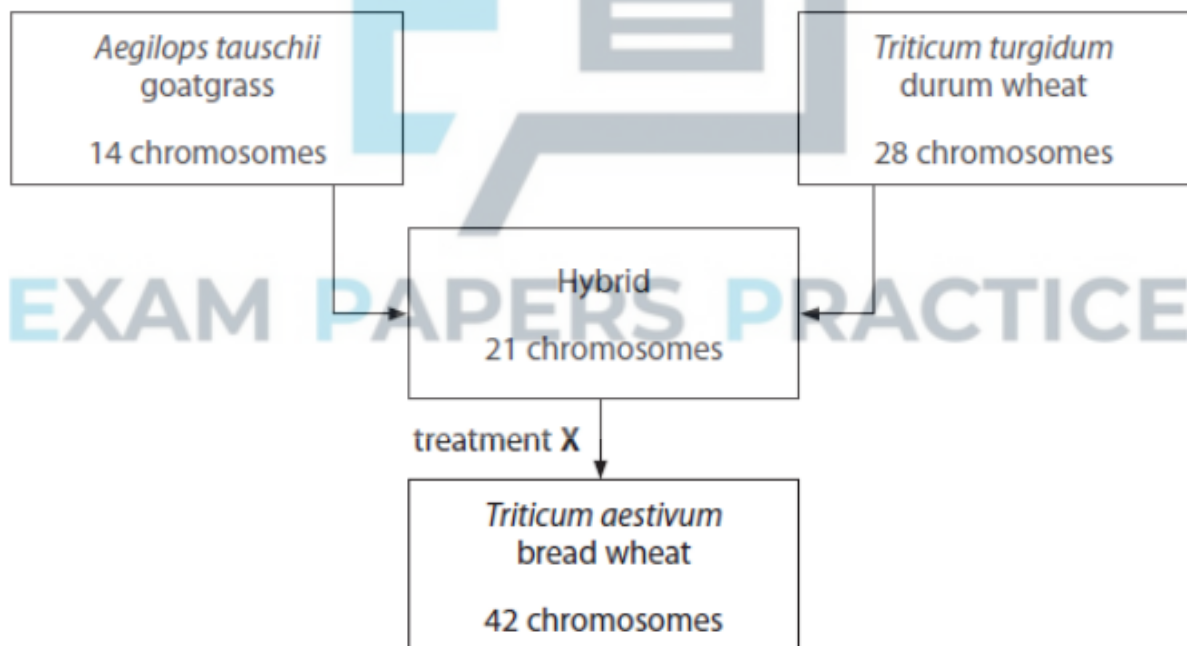
Three species of plant and their genomes are shown in the images.



## EXAM PAPERS PRACTICE



The diagram shows how chromosomes from different species have combined to produce the bread wheat species used to produce flour.



\* New varieties of plants with desirable combinations of characteristics can be produced using the methods shown in the table.





Method	Example
Formation of hybrids	In wheat, genome D includes genes for a tolerance of harsh conditions and genome A promotes large starch stores in seeds.
Genetic modification	Production of specific molecules in plant cells.
Selective breeding	Plants with desired characteristics can be used for breeding to produce plants with combinations of desired characteristics.

Evaluate the risks and benefits of producing varieties of plants using these methods.

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(Total for question = 6 marks)

Q13.

The scientific article you have studied is adapted from articles from Nature, Scientific American and the ScienceDaily website.

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

(a) Give the name of the 'simpler molecules' produced by the breakdown of glucose that can enter the mitochondria (paragraph 3).

(1)

(b) (i) Describe the role of oxygen in the 'last reaction' involved in aerobic respiration in the mitochondria (paragraph 3).

(1)

(ii) Explain how carbon monoxide reduces the production of ATP in the electron transport chain (paragraphs 3 and 4).

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(c) Explain how nitric oxide (NO) released by nerve endings could result in vasoconstriction of blood vessels (paragraphs 7 and 9).

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(d) Explain how free radicals may be involved in the production of P53 in the cell (paragraph 17).

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(e) Describe **three** structural differences between the inner mitochondrial membrane and the outer mitochondrial membrane (paragraphs 18 and 19).

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(f) Long wavelengths of light, in the near infrared (NIR) spectrum, appear to be able to modulate cell respiration by affecting cytochrome oxidase (paragraph 30).

Deduce how this may explain why NIR phototherapy has 'shown promise' in reducing cell death caused by myocardial infarction (paragraph 34).

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(g) (i) Describe how scientists could have produced 'genetically modified neurons' described in paragraphs 38 and 39.

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(ii) A light sensitive protein is channelrhodopsin-2. This is a channel protein that spans membranes. When exposed to blue light these channel proteins open and allow sodium ions to flow through. Explain how a brief flash of light could cause neurotransmitter to be released by 'the genetically modified neurons' (paragraphs 38 and 39).

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(h) Explain how fMRI allowed Vandewalle to make the observations described in paragraph 50.

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**(Total for question = 30 marks)**

Q14.

The muscles of the earthworm (*Lumbricus terrestris*) contract when it is touched. This is known as the withdrawal response.

Contraction of the muscle in the withdrawal response is stimulated by nerve impulses.

These nerve impulses can be detected using electrodes.

Explain the electrical changes in an axon that allow these nerve impulses to be detected.

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EXAM PAPERS PRACTICE (Total for question = 4 marks)

Q15.

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.



(i) Explain how a single base mutation can lead to an altered primary structure of enzyme G.

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(ii) Explain how human genome sequencing can be used to identify the mutations associated with MPS I.

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**(Total for question = 6 marks)**





Q16.

People with Guillain-Barré syndrome (GBS) suffer from a rapid onset of muscle weakness. It is thought that GBS is caused by damage to the peripheral nervous system.

In individuals with GBS, the immune system attacks and destroys the myelin sheath surrounding some neurones.

Neurone conduction was studied in an individual with GBS and in an individual without GBS. The results are shown in the table.

Individual	Sensory neurone		Motor neurone	
	Speed of conduction / metres per second	Size of action potential / mV	Speed of conduction / metres per second	Size of action potential / mV
With GBS	54	35	39	10
Without GBS	58	33	63	10

Explain why GBS caused muscle weakness in this individual.

EXAM PAPERS PRACTICE

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Q17.

The scientific article you have studied is adapted from several sources.

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

Explain why genetically modified bacteria delivering drugs 'to the exact tissue in the body where they're needed and nowhere else' would decrease side effects (paragraph 34).

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EXAM PAPERS PRACTICE

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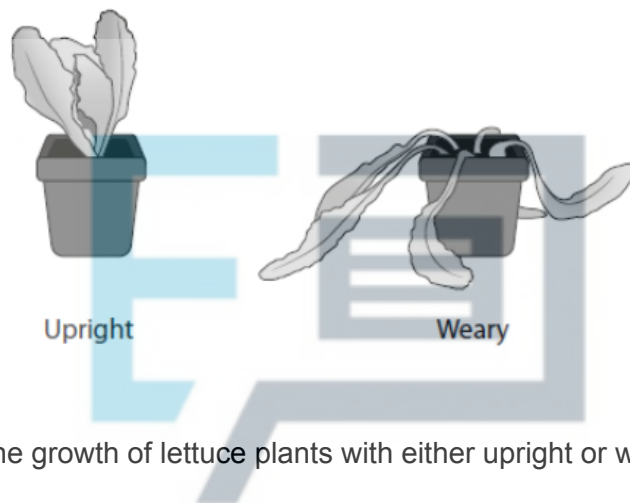
**(Total for question = 2 marks)**

Q18.

Lettuce plants usually grow upright. This is the 'upright' phenotype.

In one variety of lettuce the stem of the lettuce grows along the ground. This is the 'weary' phenotype.

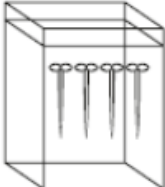
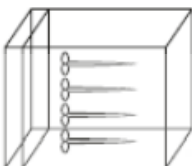
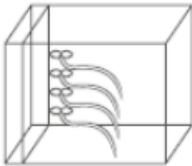
These two phenotypes are shown in the diagram.



The effect of gravity on the growth of lettuce plants with either upright or weary phenotype was investigated.

The diagram shows the stages in this investigation.



<p>Stage A</p> 	<p>Lettuce plants were grown until their stems were 15 cm long.</p>
<p>Stage B</p> 	<p>The lettuce plants were then placed in complete darkness and rotated so that they were at 90° to the direction of gravity.</p>
<p>Stage C</p> 	<p>The curvatures of the stems (<math>\alpha</math>) and roots (<math>\theta</math>) were measured for the next 23 days.</p>

(i) Explain why the plants were placed in a box in complete darkness.

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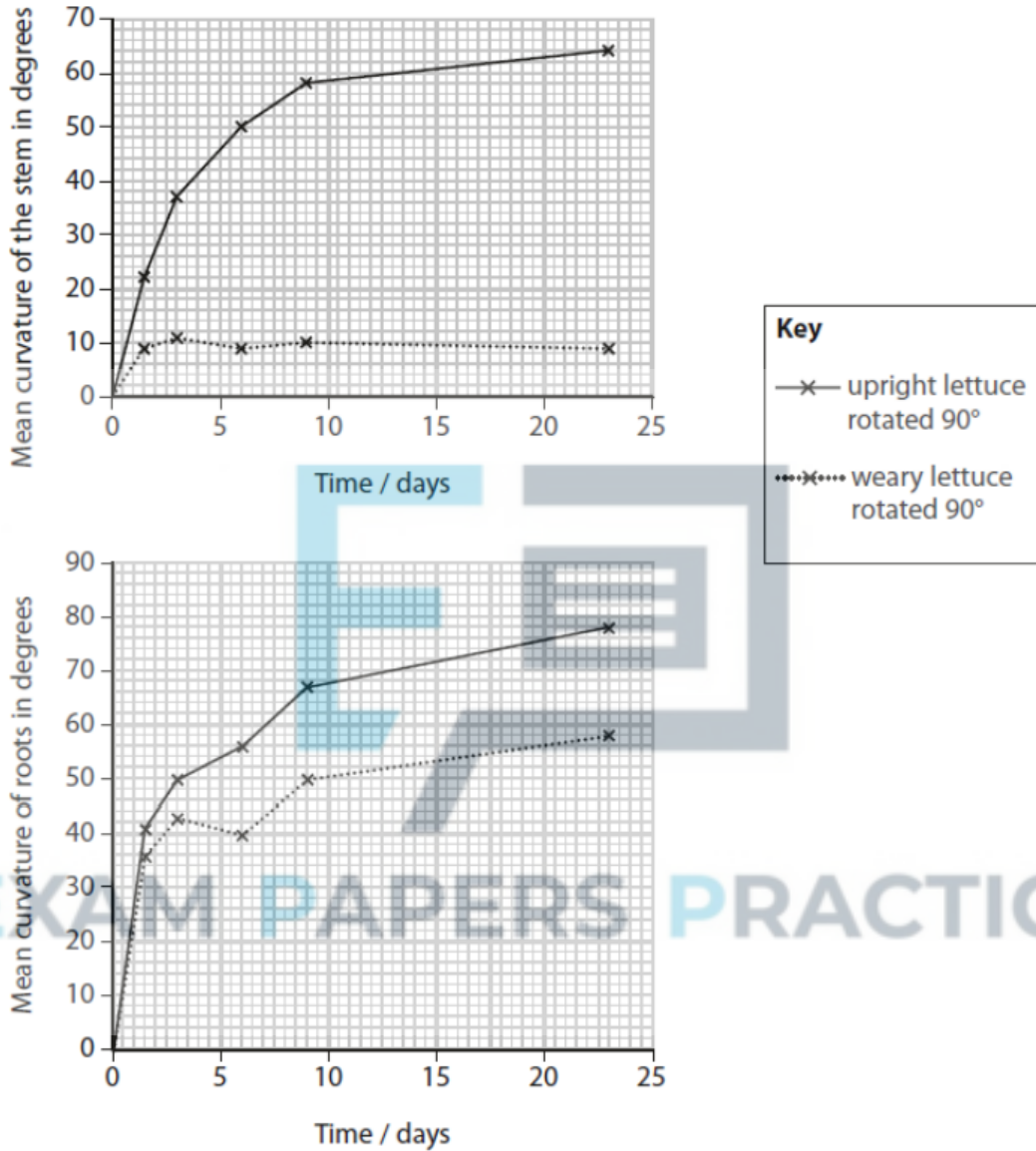
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(ii) The mean curvatures of the stems and the roots are shown in the graphs.



Calculate the difference in the mean rate of curvature of the stems and roots of the weary lettuce plants over 23 days.

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Answer .....

(iii) Explain why the stems of weary lettuce do not respond to gravity.



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(Total for question = 7 marks)

Q19.

Habituation is a learning response observed in many types of animal.

Scientists are using fruit fly habituation to investigate the role of genes associated with human autism spectrum disorders (ASD).

Before they can do this, the scientists first identify genes linked to human ASD.

Describe how genes linked to human ASD could be identified.

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(Total for question = 2 marks)

Q20.

The human brain is an organ that has a range of functions.

A student produced a table linking three descriptions of brain function to a labelled diagram of the brain.

Label	Description of function of labelled region in brain
1	Site where more synapses are formed during the critical window for vision
2	Required for the fine motor skills to draw a straight line
3	Area that sends impulses to the sinoatrial node (SAN) in response to a lowering of blood pH

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Which diagram of the brain correctly matches the table?

(1)

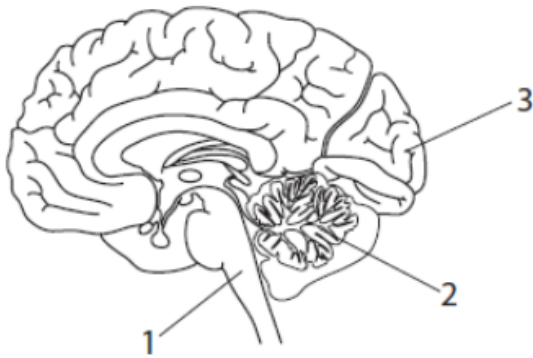


Diagram A

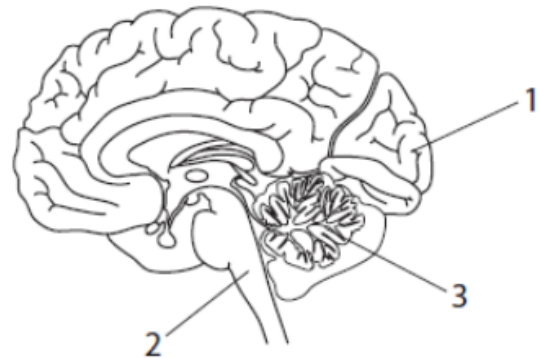


Diagram B

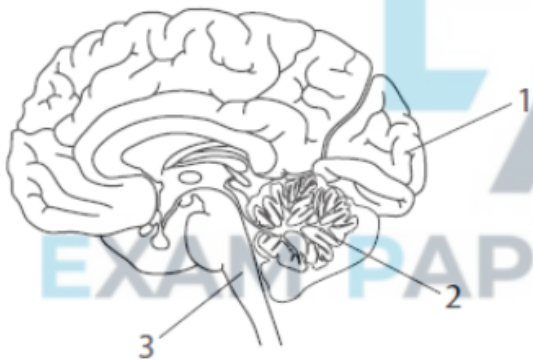


Diagram C

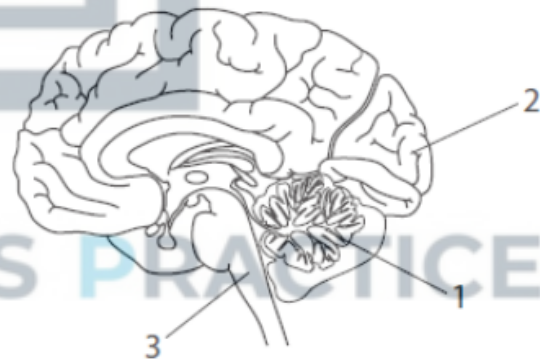


Diagram D



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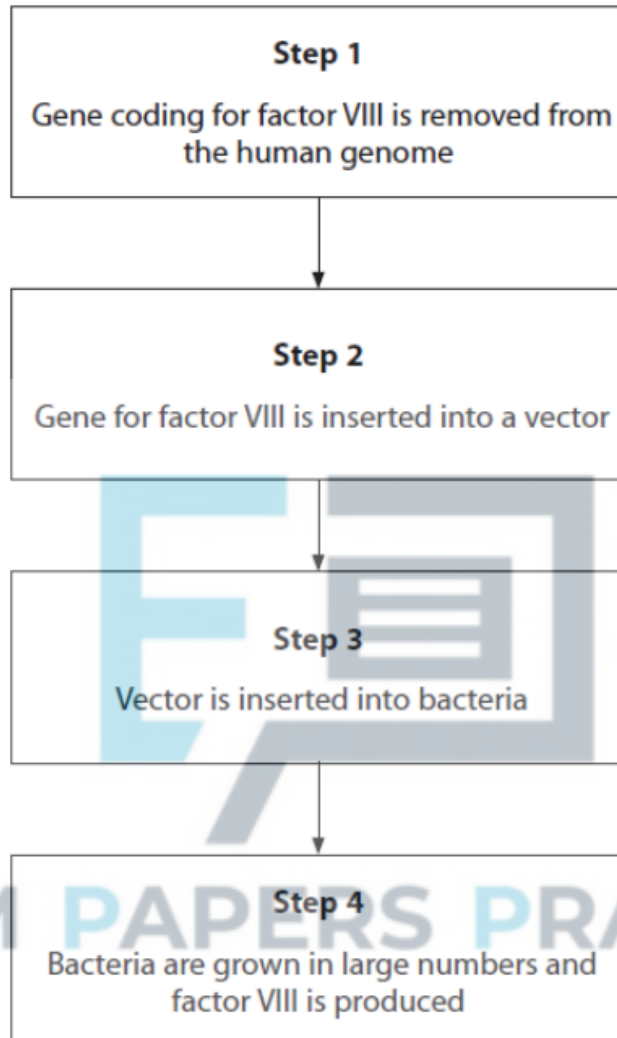
Q22.

Haemophilia is a genetic disorder where blood does not clot normally.

It can be treated by injecting factor VIII, a protein involved in the blood-clotting process that is not produced by people with haemophilia type A.

Bacteria can be genetically modified to produce factor VIII.

(a) The diagram shows some of the steps involved in genetically modifying bacteria to produce factor VIII.



EXAM PAPERS PRACTICE

(i) Describe the difference between a gene and the genome

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(ii) Give the name of the type of enzyme that would be used to insert the gene into the DNA of the vector at Step 2.

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(iii) Give an example of a suitable vector that would be used in Step 2 or 3.

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(iv) Describe how the genetically modified bacteria would use the gene from the human genome to produce factor VIII in Step 4.

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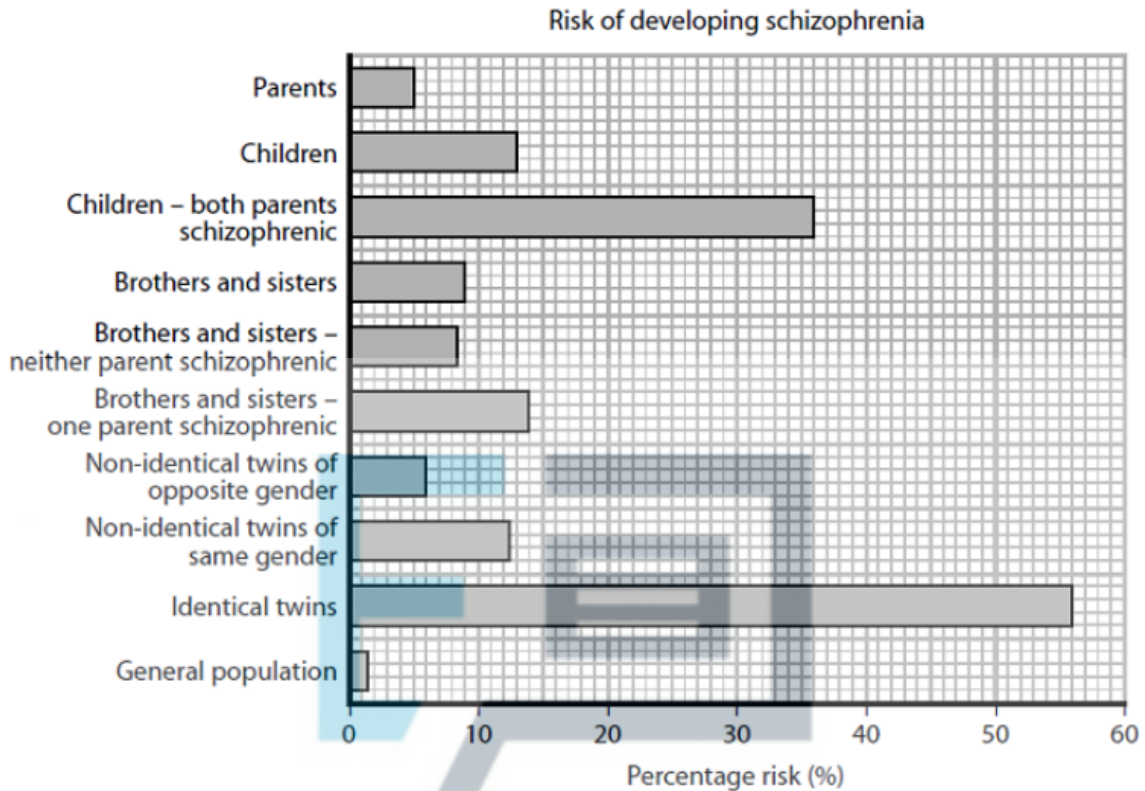
EXAM PAPERS PRACTICE

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(b) Factor VIII is required for the activation of prothrombin.

Explain why the blood-clotting process does not take place normally when a person with haemophilia type A cuts their hand.





© Courtesy of Dr. Debby Tsuang, University of Washington/VAPuget Sound Health Care System, Seattle, WA, USA.

(a) Explain the difference between the percentage risks of developing schizophrenia in identical twins and non-identical twins of the same gender.

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(b) Some early studies of schizophrenia included identical twins raised in separate families.

(i) Explain how the design of these studies allows the influence of environmental factors on the development of schizophrenia to be investigated.



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(ii) The conclusions based on these early studies of identical twins raised in separate families are said to lack validity.

Give **two** reasons why these studies may lack validity.

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EXAM PAPERS PRACTICE

(c) Schizophrenia has been linked to abnormally high levels of a neurotransmitter in the brain.

Explain how the action of the drugs used to treat schizophrenia may lead some patients to experience symptoms similar to those of Parkinson's disease.

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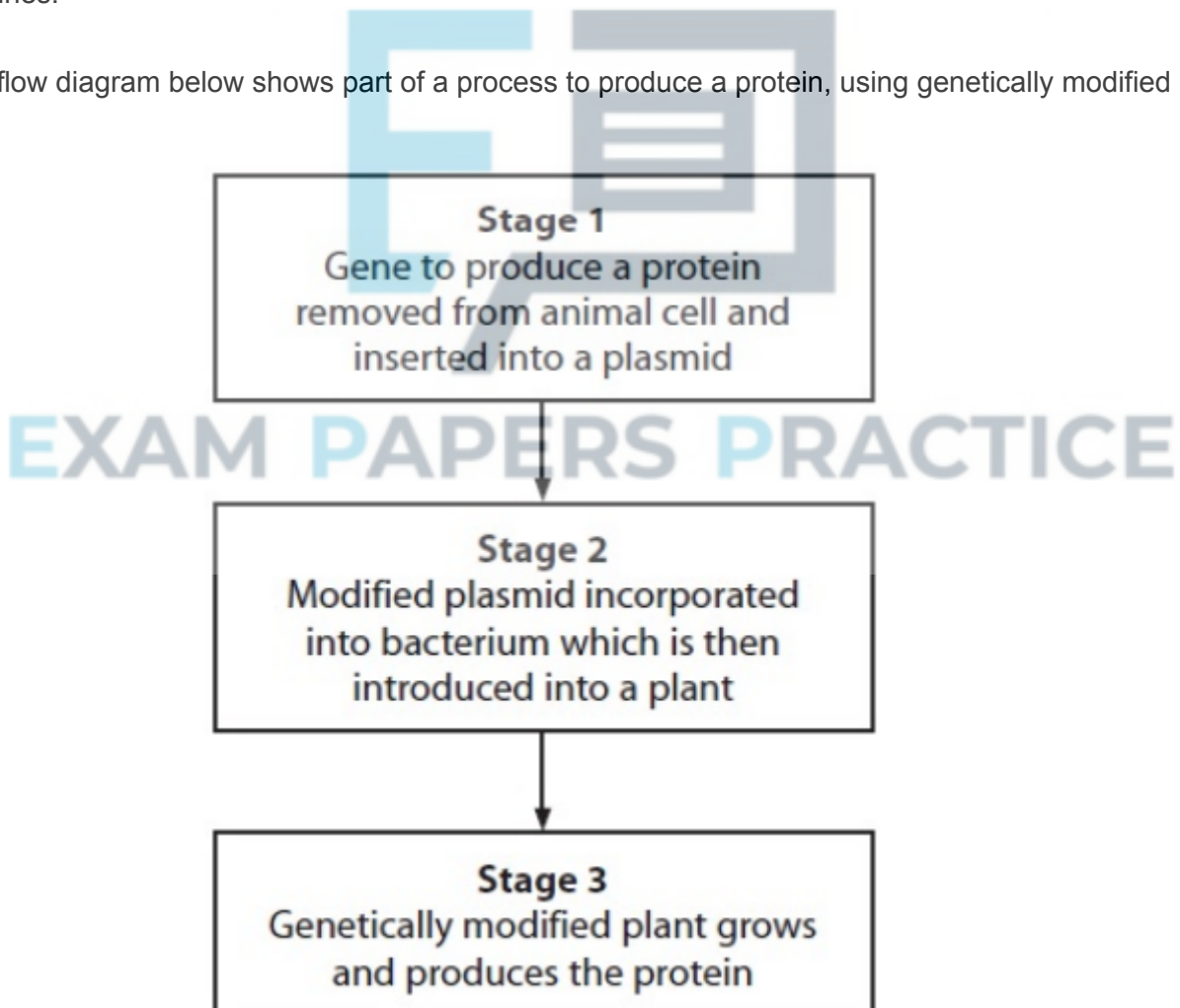
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(Total for question = 11 marks)

Q24.  
Some organisms have been genetically modified to produce proteins including hormones and vaccines.

The flow diagram below shows part of a process to produce a protein, using genetically modified plants.



(a) Describe and explain the role of the enzymes involved in stage 1.





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(b) Describe the structure of the modified plasmid used in stage 2.

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(c) Suggest why plants rather than bacteria are used to produce the protein in stage 3.

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(d) Describe **two** risks associated with the use of genetically modified organisms.

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**(Total for question = 11 marks)**



Q25.

The scientific article you have studied is adapted from an article from *'The Scientist'*.

Use the information from the scientific article and your own knowledge to answer the following questions.  
State what is meant by the genome of a thermophile (paragraph 14).

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**(Total for question = 1 mark)**