

Grey Matter -3

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 -3

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.

The nervous system is made up of many different neurones including those involved in reflex actions.

(a) The table below shows features of three types of neurone in a spinal reflex. Place a cross ☒ in the box if the feature is present in any of the named neurones.

(4)

Feature	Type of neurone		
	Sensory	Relay	Motor
Found only in the central nervous system	☒	☒	☒
Cell terminates at the effector	☒	☒	☒
Pre-synaptic membrane not found in the central nervous system	☒	☒	☒
Impulse stimulated by the receptor	☒	☒	☒

(b) Rod cells and muscle cells in the eye both require ATP

(i) Name the chemical reaction that occurs when ATP is broken down.

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(ii) Describe the function of ATP in a rod cell soon after a person has moved from an area of bright light to an area of low light.

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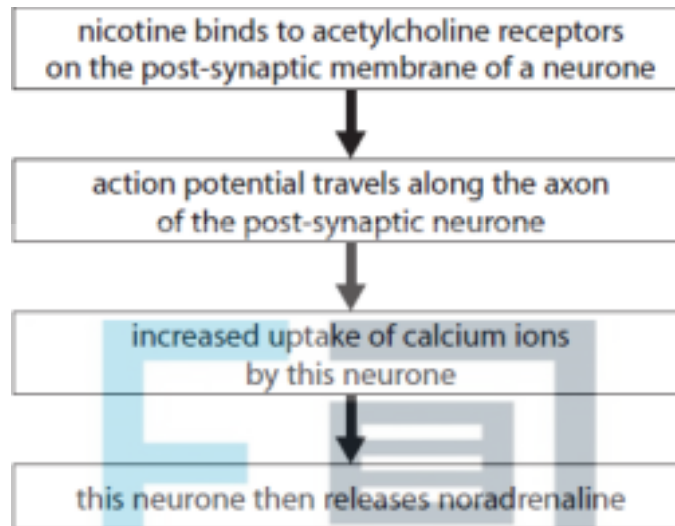
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Q2.

Nicotine is a drug found in the smoke of cigarettes.

The flow diagram shows how the presence of nicotine can cause the release of noradrenaline.



(i) Explain how nicotine causes an action potential in the post-synaptic neurone that releases noradrenaline.

EXAM PAPERS PRACTICE

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(ii) State how an increase in calcium ion uptake by the neurone leads to the release of noradrenaline.

(1)



(Total for question = 4 marks)

Q3.

The scientific article you have studied is adapted from several sources. Use the information from the article and your own knowledge to answer the following questions.

(a) The sweet potato eaten by naked mole rats (paragraph 3) is very rich in starch. Starch can be a combination of amylose and amylopectin.

Give **two** structural differences between amylose and amylopectin.

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(b) Explain why a colony of naked mole rats is considered 'a eusocial society' (paragraph 4).

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(c) Naked mole rats show evidence of poikilothermy (paragraph 5).

(i) Explain what is meant by the term **poikilothermic**.

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(ii) Suggest how each of the following 'contribute to poikilothermic responses to changing temperature of this mammal'.

'Lack of an insulating layer'

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'A marked reduction in sweat glands'

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(d) Suggest a mechanism that could have been used to genetically modify cells from mice with cancer-causing genes (paragraph 13).

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*(e) Whilst naked mole rats are 'impervious to chemical pain' they do feel 'acute pain such as cuts and burns' (paragraph 31).

Touching something hot, which could lead to a burn, can cause nerve impulses to travel along myelinated sensory neurones very rapidly.

Explain how myelination increases the speed of transmission of nerve impulses in a sensory neurone.

(5)



EXAM PAPERS PRACTICE

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(f) Explain how a heart attack can temporarily reduce the oxygen concentration in brain tissue (paragraph 36).

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(g) Using the information in paragraph 48, name **one** hormone **and** state its function.

(1)

Hormone:

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Function:

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(h) Suggest how a change in the mid region of the sperm may make it non-motile (paragraph 48).

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(i) Disperser naked mole rats 'are laden with fat' (paragraph 50).

Suggest why it may be advantageous for disperser naked mole rats to have high levels of fat.

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(j) Explain the statement that 'a preference by reproductively active females for unfamiliar males is interpreted as inbreeding avoidance' (paragraph 52).

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(k) 'The naked mole rat hasn't yet had its genome sequenced' (paragraph 53).

Explain what is meant by the term **genome sequenced**.

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(l) 'With so much to offer science, it is no surprise that naked mole rats are becoming more common in labs' (paragraph 53).

Using information from the article, describe **two** adaptations of naked mole rats. For each adaptation, explain why it could be of interest in a medical research laboratory.

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(Total for Question = 30 marks)

Q4.

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.

'Most drugs cannot easily penetrate the brain' (paragraph 3).

Explain how the treatment of Parkinson's disease overcomes the difficulty of drugs passing from the blood into the brain.

EXAM PAPERS PRACTICE

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(Total for question = 2 marks)

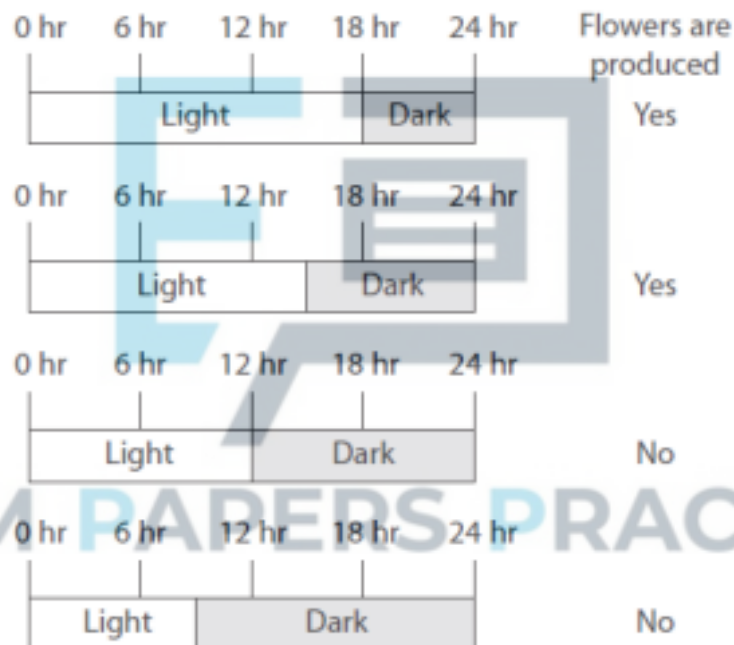


Q5.

Both plants and animals are able to respond to stimuli using photosensitive pigments.

(a) The photosensitive pigment in plants can be involved in a range of responses to environmental cues. This includes flower production in response to day length.

The diagram below shows the results of a study on the effect of day length on flowering in one species of plant.



(i) Place a cross in the box to complete the conclusion made using these results. The critical amount of daylight needed for the production of flowers is

(1)

A between 15 and 18 hours

B between 12 and 15 hours

C between 9 and 12 hours

D between 6 and 9 hours



(ii) The photosensitive pigment involved in making this plant species produce flowers is likely to be

(1)

- A IAA
- B chlorophyll
- C FAD
- D phytochrome

(iii) Suggest how the plants were grown to ensure this study was valid.

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(iv) Suggest how this study could be changed to produce a more accurate conclusion.

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(b) For some plant species, day length is not an environmental cue for the production of flowers. Suggest **one** environmental cue, other than day length, that could stimulate plants of these species to produce flowers.

(1)



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(c) Rhodospin is found in rod cells in the retina of mammalian eyes.

(i) State the location of rhodopsin within a rod cell.

(1)

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(ii) In the table below, place a tick (✓) in the box if the statement applies to the description and place a cross (✗) in the box if the statement does not apply.

(3)

Description	Statement		
	Opsin binds to the rod cell membrane	Rhodopsin bleaches	ATP used
Rhodopsin responding to light			
Rhodopsin being reformed			

(Total for question = 10 marks)



Q6.

An experiment was carried out to investigate mineral deficiencies on the growth of seedlings. The effects of two mineral deficiencies on two different species of plant were investigated.

Test tubes were half filled with an aqueous gel containing a mineral solution without calcium ions. Seeds of rice or fenugreek were placed separately in these test tubes.

These test tubes were placed by a window for two weeks to allow the seeds to germinate and the seedlings to grow.

This was repeated using test tubes containing mineral solution without magnesium ions.

The only source of light provided for the plants was from outside the window. All of the seedlings grew towards the window.

Explain the reason for this response of these seedlings to light.

(3)

EXAM PAPERS PRACTICE

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 .

Phytochromes and IAA (indole acetic acid) are important substances that bring about growth responses in plants.

Phytochrome is found in two different forms known as P_R (or P_{660}) and P_{FR} (or P_{730}).

(i) Which row correctly describes the effects of sunlight on phytochrome?

(1)

	Change in form of phytochrome	Speed of change
<input checked="" type="checkbox"/> A	P_{FR} to P_R	slow
<input checked="" type="checkbox"/> B	P_{FR} to P_R	rapid
<input checked="" type="checkbox"/> C	P_R to P_{FR}	slow
<input checked="" type="checkbox"/> D	P_R to P_{FR}	rapid

(ii) Phytochrome can be described as

(1)

- A a form of opsin
- B a photosensitive pigment
- C an isomer of retinal
- D a type of cytochrome

(iii) Give one example of a growth response of a plant that is affected by phytochrome.

(1)

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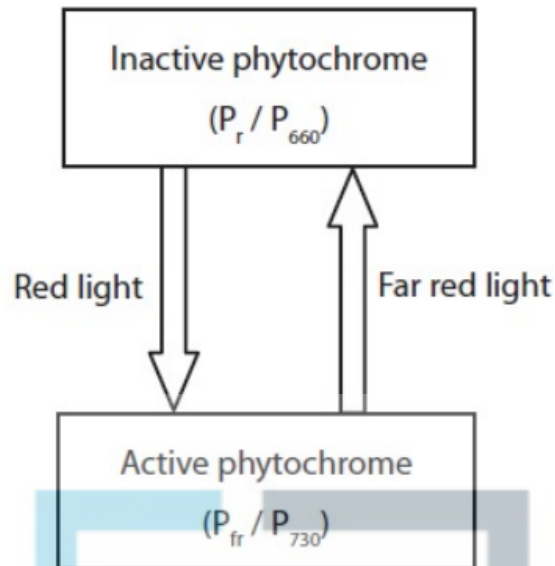
(Total for question = 3 marks)

Q8.

EXAM PAPERS PRACTICE

Phytochromes are photoreceptors found in many plants.

(a) The diagram below shows the interconversion of inactive phytochrome (P_r / P_{660}) and active phytochrome (P_{fr} / P_{730}).



State **one** way in which the active form of phytochrome can be converted back to the inactive form, other than by exposing it to far red light.

(1)

(b) A study was carried out to investigate the effect of red light and far red light on sunflower plants.



A sunflower
Magnification $\times 0.5$



One group of sunflower seedlings, group A, was grown under a lamp that emitted red light and far red light of the same intensity.

Another group of sunflower seedlings, group B, was grown in the same way, except that the lamp emitted a lower intensity of red light. The intensity of far red light was unchanged.

When the plants were fully grown, the mean dry mass of the flowers produced and the mean length of the plant stems were recorded.

This study was repeated using new groups of sunflower seedlings.

The results are shown in the table below.

Study	Mean dry mass of the flowers / g		Mean stem length / cm	
	Group A	Group B	Group A	Group B
Original	58	45	125	148
Repeat	43	38	124	142

(i) Using the mean dry mass of the flowers shown in the table, compare the results of group A with group B for both the original and repeat studies.

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(ii) The light conditions experienced by group B were similar to those found near ground level in woodland.

Using the mean stem lengths shown in the table, suggest the importance of these light conditions for a young seedling in the woodland.

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(iii) A statistical analysis of the data for mean stem length was carried out.

The analysis showed that there was a significant difference between the mean stem length data for groups A and B. However, there was no significant difference between the data from the original study and the repeat study.

Suggest a conclusion for the effect of light on mean stem length and use the results of this statistical analysis to comment on the reliability of the data.

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(Total for question = 10 marks)

Q9.

The response of an animal to a stimulus can change if the stimulus is repeated.

The photograph shows the head and part of the body of a marine worm that lives in a chalky tube.



© Johner Images / Alamy

The worm moves its head out of the tube to feed. The worm will withdraw into its tube if it senses danger and any change in length of the worm can be measured.

An investigation was carried out to study the response of ten worms to a moving shadow and to touch. Five of the worms were kept in their tubes and the other five were removed from their tubes. A shadow was moved over the worms and the decrease in length of each worm was recorded.



The investigation was repeated with another 10 worms but the stimulus used was touch instead of a moving shadow.

The results are shown in the table below.

Worms	Mean decrease in length / cm	
	Moving shadow	Touch
In tube	1.08	2.03
Not in tube	0.01	1.53

(a) Calculate the percentage difference in the response of the worms to touch.

(2)

Answer

(b) Analyse the data to explain the difference in the withdrawal response of the worms to the different stimuli.

(3)

EXAM PAPERS PRACTICE

(c) When the touch stimulus is applied several times to the worms, they learn to reduce the withdrawal response.

(i) Give **two** advantages for worms with this type of learning behaviour.

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(ii) Explain how repeated touch stimulation reduces the withdrawal response.

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(Total for question = 12 marks)

Q10.

EXAM PAPERS PRACTICE

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 bacteria can be genetically modified to produce a cytokine for the treatment of neurological and mental disorders (paragraph 24).

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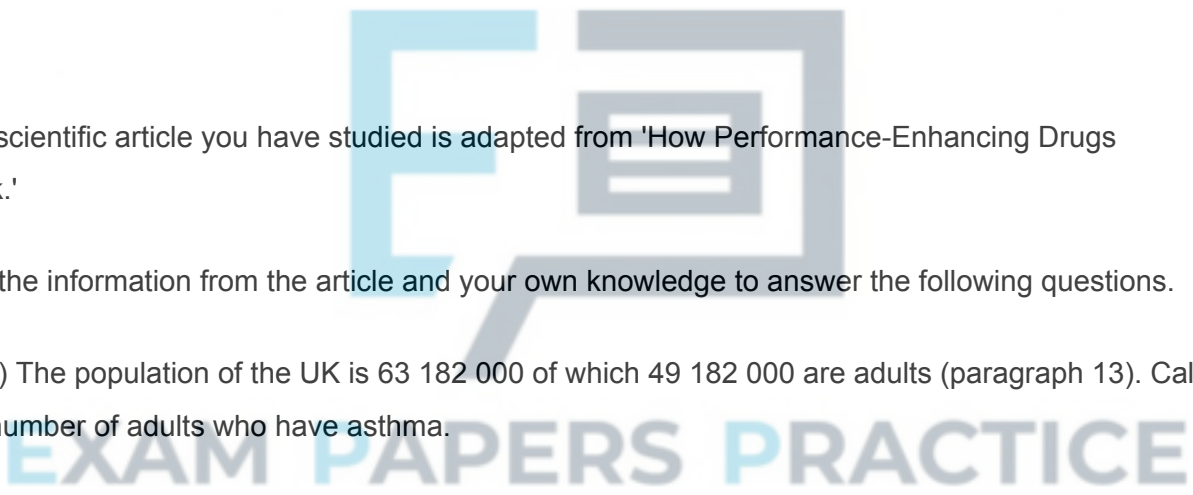
(Total for question = 4 marks)

Q11.

The scientific article you have studied is adapted from 'How Performance-Enhancing Drugs Work.'

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

(a) (i) The population of the UK is 63 182 000 of which 49 182 000 are adults (paragraph 13). Calculate the number of adults who have asthma.



(2)

Answer

(ii) People with asthma sometimes have difficulty breathing (paragraph 13). Explain how beta-2 agonists may help to relieve their symptoms.

(2)

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(iii) Explain how beta-2 agonists can increase the heart rate (paragraph 13).

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(b) Explain how human growth hormone (HGH) is able to stimulate cells to secrete IGF-1 (paragraphs 20 and 21).

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(c) Explain why it is difficult to identify athletes who are using banned substances such as HGH (paragraphs 17, 20 and 22).

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(d) Explain one benefit of using substances developed from perfluorocarbons (PFCs) to treat patients with breathing difficulties (paragraphs 30 and 31).

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(e) Local anaesthetics mask pain by binding to protein channels in the membranes of neurones (paragraph 38).

Explain how binding to protein channels will prevent pain being sensed by the pain centre of the brain.

(4)

EXAM PAPERS PRACTICE

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(f) Explain why diuretics are a prescribed drug for high blood pressure (paragraph 43).

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(g) A test for the T/E ratio can help to identify athletes who have injected testosterone into their body (paragraph 45).

Explain the limitation of this test.

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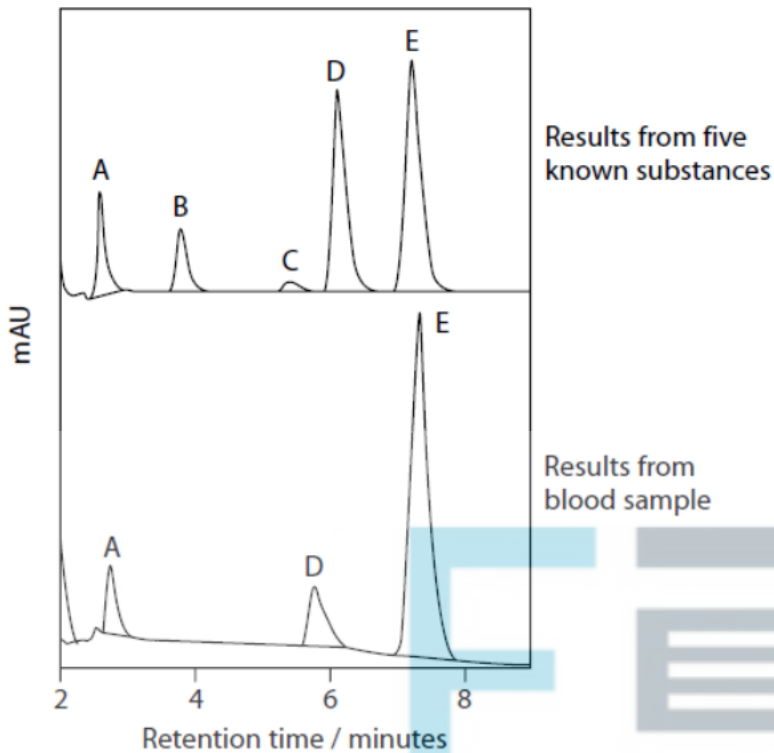
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(h) Gas chromatography (GC) can be used to detect athletes who have taken banned drugs (paragraph 48).

The chromatogram shows the GC results for five known banned substances, A, B, C, D and E.



Explain why the peak for drug E is different from the peak for drug A (paragraph 48).

(2)

EXAM PAPERS PRACTICE

(i) Explain how the blood passport may result in more effective monitoring of athletes (paragraph 51).

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(j) Comment on the ethical viewpoints for and against the use of performance-enhancing drugs by athletes.



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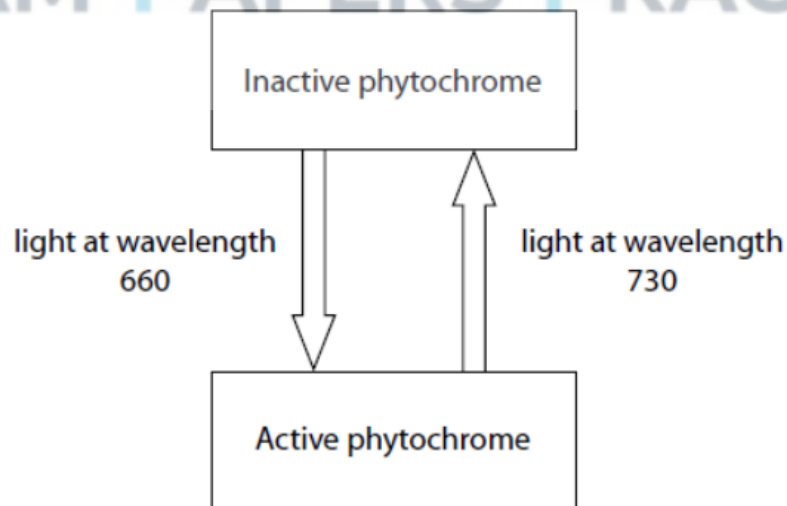
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(Total for question = 33 marks)

Q12.

Phytochromes are photoreceptors found in many plants.

The diagram below shows the interconversion of inactive phytochrome (Pr / P660) and active phytochrome (Pfr / P730).



Which row of the table correctly shows the light conditions that convert the active form of phytochrome back to the inactive form?



(1)

				Light condition		
				exposed to red light	exposed to far red light	exposed to darkness
<input checked="" type="checkbox"/>	A	yes	no	yes		
<input checked="" type="checkbox"/>	B	no	yes	no		
<input checked="" type="checkbox"/>	C	no	yes	yes		
<input checked="" type="checkbox"/>	D	yes	no	no		

(Total for question = 1 mark)

Q13.

Rod cells in the eye are linked to the brain by neurones.

(a) Place a cross in the box to identify the answer that correctly completes each statement.

(i) The pigment in a rod cell is made of opsin and

(1)

- A** retina
- B** retinal
- C** retine
- D** retinol

(ii) When light stimulates a rod cell the pigment changes.

This pigment is

(1)

- A** iodopsin
- B** phytochrome far red
- C** phytochrome red
- D** rhodopsin

(iii) Once the pigment has changed, the concentration of sodium ions inside the rod cell

(1)

- A** decreases
- B** does not change
- C** increases
- D** reaches equilibrium with the outside of the cell

(iv) After changing, the pigment takes time to become functional again. This is because

(1)

- A** it has to bleach
- B** the membrane has to be polarised
- C** the rod cell needs to reset
- D** two components have to be rejoined

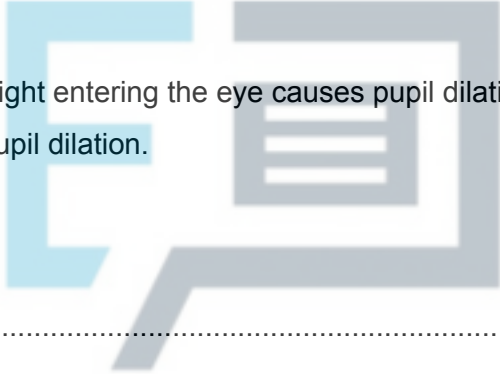
(v) The cell that links a rod cell to a sensory neurone is

(1)

- A a bipolar neurone
- B a multipolar neurone
- C a unipolar neurone
- D an optic nerve

(b) Decreasing the intensity of light entering the eye causes pupil dilation. Describe the roles of the circular and radial muscles in pupil dilation.

(2)



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EXAM PAPERS PRACTICE

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(Total for Question = 7 marks)

Q14.

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.

Give two reasons why some people may be concerned about the use of genetically modified alfalfa as a source of spider silk.

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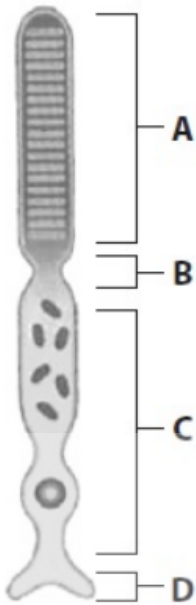
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EXAM PAPERS PRACTICE (Total for question = 2 marks)

Q15.

The retina of the eye is sensitive to light. It contains rod cells.

The diagram below shows a rod cell. Parts of this cell are labelled **A**, **B**, **C** and **D**.



(a) The table below gives three descriptions of parts of the rod cell. Place a cross in the box to identify the part of the rod cell described.

(3)

Description	Part of the rod cell			
	A	B	C	D
Nearest the pupil of the eye	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Containing the photosensitive pigment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Has a pre-synaptic membrane	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

(b) When light reaches a rod cell the voltage across the cell surface membrane can change. This can lead to the formation of an action potential in an optic neurone.

(i) Describe how light causes a change in the voltage across the cell surface membrane of a rod cell.

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(ii) Suggest why a change in voltage across the cell surface membrane of a rod cell may not lead to the formation of an action potential in an optic neurone.

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EXAM PAPERS PRACTICE

(Total for Question = 9 marks)

Q16.

Humans have a nervous system that has a variety of neurones.

The human brain is made up of a number of areas containing many millions of neurones.

Place a cross in the box that identifies the areas of the brain associated with riding a bicycle uphill.

(i) the decision to ride the bicycle

(1)

A cerebrum

B cerebellum

C hypothalamus

D medulla

(ii) initiating an increase in sweating during the ride

(1)

A cerebrum

B cerebellum

C hypothalamus

D medulla

Q17.

The scientific article you have studied is adapted from the book called *The Immortal Life of Henrietta Lacks* by Rebecca Skloot. Published by Pan Books in 2011.

(a) Explain what is meant by the term **mitosis** (paragraph 7).

(2)



(d) 'Like guinea pigs and mice, Henrietta's cells have become the standard laboratory workhorse' (paragraph 16).

Suggest **two** reasons why it is preferable to use Henrietta's cells in medical research, rather than using guinea pigs and mice.

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* (e) 'By the end of 1951, the world was in the midst of the biggest polio epidemic in history' (paragraph 19). This was caused by poliovirus which can lead to paralysis (paragraph 20).

The virus infects motor neurones which can stop skeletal muscles from working.

Suggest how an infection of motor neurones by the virus can stop the transmission of nerve impulses and lead to muscle paralysis.

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(f) Poliovirus, like Human Immunodeficiency Virus, is a retrovirus. Poliovirus was able to infect HeLa cells (paragraph 25).

Give **three** similarities between the structure of the genetic material in poliovirus and the genetic material in HeLa cells.

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(g) Scientists had studied genes by breeding plants 'then breeding their offspring to see how genetic traits are passed from one generation to the next' (paragraph 33).

When this was done using a smooth pea and a wrinkled pea, it was found that in the F₂ generation (second generation of offspring), 75% were smooth.

In the space below, draw genetic diagrams to describe and explain the genotypes of the parents and their offspring in the previous **two** generations.

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(h) Explain what is meant by the term **human genome map** (paragraph 37).

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(i) Suggest how the 'p53 tumor suppressor gene' (paragraph 43) could stop a potential tumour cell forming.

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(j) Using paragraph 46, suggest what the 'specific DNA sequence from a blood cell' coded for.

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(k) A human telomere (paragraph 60) contains 10 000 nucleotides. Using information from paragraph 58, state the number of telomere nucleotides lost per cell division.

(1)

Answer nucleotides

(Total for question = 30 marks)

Q18.

The scientific article you have studied is adapted from the book called *The Immortal Life of Henrietta Lacks* by Rebecca Skloot, published by Pan Books in 2011.

(a) MPF triggering (paragraph 6) starts the process of mitosis. Suggest **three** events that occur at the beginning of mitosis in a plant cell that may be triggered by MPF.

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(b) The genome makes sure that cells 'do their jobs, whether that's controlling your heartbeat or helping your brain understand the words on this page' (paragraph 10).

Suggest how cells sensitive to pH are involved in controlling heart rate.

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(c) 'Like guinea pigs and mice, Henrietta's cells have become the standard laboratory workhorse' (paragraph 16).

Suggest **three** reasons why Henrietta's cells are used routinely in medical research.

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*(d) 'By the end of 1951, the world was in the midst of the biggest polio epidemic in history' (paragraph 19). This was caused by poliovirus which can lead to paralysis (paragraph 20).

The virus infects motor neurones which can stop skeletal muscles from working.

Explain how the structure of the cell surface membrane of a motor neurone is related to the conduction of a nerve impulse along its axon.

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(e) Poliovirus, like Human Immunodeficiency Virus, is a retrovirus. Poliovirus was able to infect HeLa cells (paragraph 25).

Give **three** differences between the structure of the genetic material in poliovirus and the genetic material in HeLa cells.



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(f) Scientists had studied genes by breeding animals 'then breeding their offspring to see how genetic traits are passed from one generation to the next' (paragraph 33).

When this was done using a brown mouse and a white mouse, it was found that in the F₂ generation (second generation of offspring), 75% of the mice were brown.

In the space below, draw genetic diagrams to describe and explain the genotypes of the parents and their offspring in the previous **two** generations.

(4)

(g) Monoclonal antibodies are produced by hybrid cells. These cells are made by fusing a lymphocyte with a cancer cell, such as HeLa (paragraph 37).

Suggest why cancer cells are used to form these hybrid cells.

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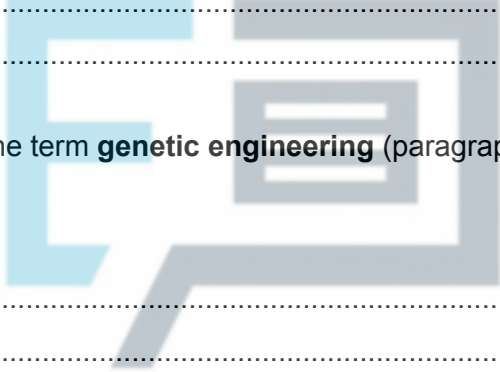
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(h) Suggest what is meant by the term **genetic engineering** (paragraph 47).

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(i) Place a cross  in the box that shows the number of cells present if one cell divided 50 times by mitosis (paragraph 58).

(1)



- A 2^5
- B 50^2
- C 5^{20}
- D 2^{50}

(j) Scientists knew that 'there was a string of DNA at the end of each chromosome called a *telomere*' (paragraph 60) and they also knew that 'human cancer cells contain an enzyme called *telomerase*' (paragraph 61).

State **four** chemical elements found in both telomeres and telomerase.

(2)

EXAM PAPERS PRACTICE

(Total for question = 30 marks)

Q19.

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

Which of the following terms describes a change in response as a result of repeated stimulation?

(1)

- A** co-ordination
- B** habituation
- C** inhibition
- D** reduction

(Total for question = 1 mark)

Q20.

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

(i) The table below identifies two stages in the transmission of an impulse in a sensory neurone.

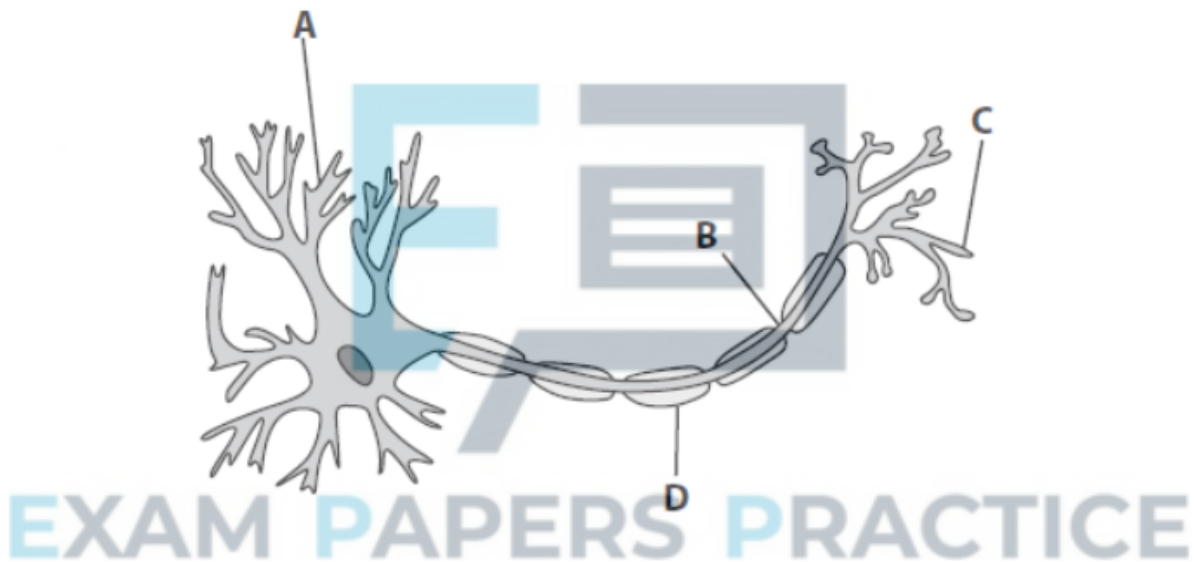
Place a tick (✓) in each box that correctly identifies whether the channels are open or closed during these two stages.

(2)



Stage	Voltage-gated K ⁺ channels open	Voltage-gated K ⁺ channels closed	Voltage-gated Na ⁺ channels closed
Depolarisation			
Repolarisation			

(ii) The diagram below shows a myelinated motor neurone.



Place a cross in the box that labels the site where neurotransmitters bind and initiate depolarisation.

(1)

A

B

C

D


Q21.

The scientific article you have studied is adapted from articles in *Nature* and *Scientific American*.

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

* Suggest how researchers had genetically modified the pathogen to 'provoke an effective immune response' (paragraph 12).

(6)



EXAM PAPERS PRACTICE

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Q22.

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 **two** reasons why some people might have objections to the use of rats in this investigation.

(2)

EXAM PAPERS PRACTICE

Q23.

The scientific article you have studied is adapted from articles in *Nature* and *Scientific American*.

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

Octopamine is a neurotransmitter (paragraph 24). Libersat and his team believe that wasp venom probably blocks octopamine receptors in the central nervous system of the cockroach.

Suggest **two** ways that the 'compound that reactivates octopamine receptors' (paragraph 25) could work.

(2)

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Q24.

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 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.

(i) The transmission of an impulse between a neurone in the optic nerve and a cell in the brain involves ions and neurotransmitter molecules.

Describe how these ions and neurotransmitter molecules are involved in the transmission of an impulse.

(4)



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(ii) The diagram shows a human brain.



Which label on the diagram identifies the area of the brain where an image is interpreted?

(1)

- A T
- B U
- C V
- D W

(Total for question = 5 marks)

Q25.

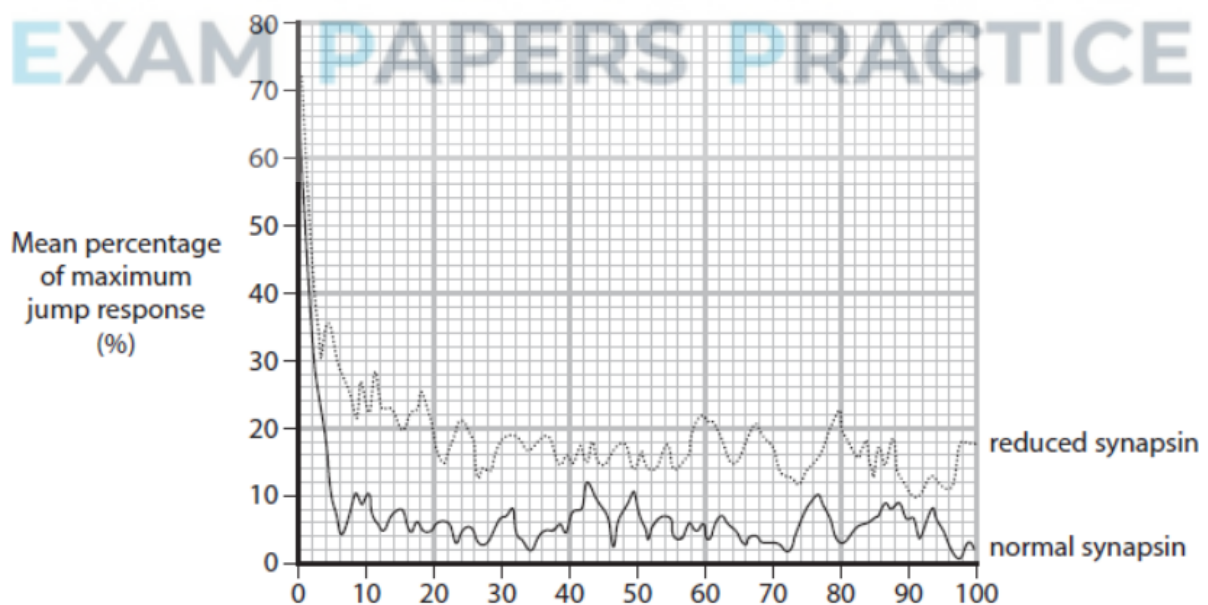
Habituation is a learning response observed in many types of animal.

The 'light-off jump' assay can be used to study habituation in fruit flies.

When the light is turned off the flies jump into the air and attempt to fly away. The strength of this response can be measured by recording the noise made by the flies.

In one experiment, fruit flies with reduced expression of a protein called synapsin were compared with a control group.

Synapsin is a protein that inhibits the binding of presynaptic vesicles to the cell membrane. The results of this experiment are shown in the graph.



(i) State two variables associated with the light-off stimulus that need to be controlled in this experiment.



(2)

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(ii) Determine the effect of reduced synapsin on the habituation of fruit flies in this experiment.

(3)



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(iii) Explain how reduced expression of synapsin could produce these results.

(3)

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(Total for question = 8 marks)



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