Cambridge Assessment International Education

Example Responses – Paper 4

Cambridge International AS & A Level Biology 9700

For examination from 2022

Cambridge Pathway

Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge International AS & A Level Biology 9700.

This booklet contains responses to all questions from June 2022 Paper 41, which have been written by a Cambridge examiner. Responses are accompanied by a brief commentary highlighting common errors and misconceptions where they are relevant.

The question papers and mark schemes are available to download from the School Support Hub.

9700 June 2022 Question Paper 41

9700 June 2022 Mark Scheme 41

Past exam resources and other teaching and learning resources are available from the School Support Hub.

Question 1

1 **(a)** The golden mantella, *Mantella aurantiaca*, is a small terrestrial frog found in Madagascar.

Fig. 1.1 shows a golden mantella.

Fig. 1.1

(i) Name the domain and kingdom to which the golden mantella belongs.

domain Eukarya

kingdom Animalia

[2]

(ii) The skin of the golden mantella is brightly coloured and contains a toxin.

Suggest a benefit to the frog of being brightly coloured.

The frog benefits because the bright colour acts as a warning to predators that the frog is toxic.

[1]

Examiner comment

Candidates needed to use both pieces of information – toxic and brightly coloured – to make a suggestion about the colour being a warning or signal about the toxicity. The frog does not need to send this signal to animals that cannot harm it, so the answer needed to include some reference to predators or animals that might otherwise approach the frog in order to eat it.

(b) The toxin in the skin of the golden mantella affects the action of the sarcomeres in muscle fibres (muscle cells) of mammalian striated muscle. The toxin inhibits a protein, Ca^{2+}ATPase, found in the membrane of the sarcoplasmic reticulum.

Ca^{2+}ATPase pumps calcium ions from the cytoplasm into the sarcoplasmic reticulum when the fibre is no longer stimulated.

Suggest the consequences to the sarcomere of the action of the golden mantella toxin.

When the fibre is no longer stimulated, the Ca^{2+} ATPase that has been inhibited by the toxin will not pump Ca^{2+} ions into the sarcoplasmic reticulum. The Ca^{2+} ions will stay in the cytoplasm and will continue to bind to troponin. The tropomyosin will not get moved back to its resting position so the myosin binding sites on the actin will stay exposed. Therefore myosin will bind to actin and the sarcomere will stay in a contracted state. [3]

Examiner comment

- The model answer uses the question information to set the scene that the action potential has passed. The 'action of the toxin' asked about in the question is linked to the inhibition of the enzyme so that it can no longer do its normal job. This is good practice for candidates to follow.
- A minority of candidates focused on methods of enzyme inhibition, such as competitive and non-competitive inhibition. They did not refer to the consequences to the sarcomere and so did not answer the question.
- The candidate is linking the 'action of the toxin' asked about in the question to the inhibition of the enzyme so that it can no longer do its normal job.
- Some candidates reasoned that the sarcomere would be prevented from contracting because the calcium ions have not been returned to their storage area in the sarcoplasmic reticulum, so will not be available to be released when the next impulse arrives. These candidates had not considered the effect of the calcium ions that were left in the cytoplasm.
- Some candidates confused the two proteins troponin and tropomyosin.
- References to binding sites did not always state where these sites were or what could potentially bind to them, i.e. that the sites are on the actin filament and that they are sites where myosin can bind.

(c) Describe the role of calcium ions in a cholinergic synapse.

Calcium ions enter the synaptic knob by diffusion because the arrival of an impulse opens calcium ion channels. The entry of calcium ions causes vesicles containing the neurotransmitter acetylcholine to move towards the presynaptic membrane. The vesicles fuse with the membrane releasing the ACh by exocytosis.

..... [3]

[Total: 9]

Examiner comment

- Some candidates incorrectly stated that the calcium ions bind to receptors on the outside of the membrane of the synaptic knob. Other common errors included statements that 'the calcium ions enter the membrane' or 'the calcium ions move into the membrane'. These statements imply incorrectly that the ions pass into the middle of the phospholipid bilayer. The ions move **through** the protein channels across both layers of the membrane and enter the cytoplasm of the synaptic knob.
- Many candidates incorrectly referred to 'synaptic knobs' as 'presynaptic knobs'. Synaptic knobs are never located on postsynaptic neurones so referring to them as presynaptic is unnecessary.
- On first mention, the full name of the neurotransmitter should be given as it is in this model response, 'acetylcholine'. Subsequently, the abbreviation ACh can be used. Candidates who did not notice that the question referred to a 'cholinergic' synapse were unable to identify acetylcholine as the neurotransmitter.
- The name or position of the membrane must be specified. A minority of candidates confused presynaptic and postsynaptic.
- A common error was to imply that the membrane-bound vesicles, rather than their contents, are released by exocytosis. During exocytosis, the membrane of the vesicles becomes part of the presynaptic membrane.

Question 2

2 **(a)** In eukaryotes, the cells of plants and photosynthetic protoctists contain chloroplasts.

Describe the relationship between the function of a chloroplast and its structure.

The chloroplast has many thylakoids. The thylakoid membranes contain photosynthetic pigments to absorb light for the light-dependent reactions. The products of the light-dependent reactions then go to the stroma where enzymes like rubisco catalyse the light-independent stage of photosynthesis. The product glucose is stored in the stroma as starch grains. [4]

Examiner comment

- Many candidates did not specify that it is the thylakoid membranes (rather than the thylakoid spaces or just generally, thylakoids or grana) that house the pigments and electron carriers.
- The model answer is concise, something candidates should try to do, naming the two main functional areas of the chloroplast and linking each name and a biochemical detail of the structure to the function of that structure.
- Many candidates mentioned the smaller components like starch grains, DNA and ribosomes without relating them to their function in the chloroplast. A significant error was that many candidates wrongly stated that the chloroplast organelle contains mitochondria.

(b) Outline the main features of cyclic photophosphorylation.

The main features of cyclic photophosphorylation are that it only involves photosystem 1 and that light excites an electron from here, which goes down the electron transport chain, making ATP by chemiosmosis, and then the electron returns to photosystem 1.

[3]

Examiner comment

Concise answers can be effective, providing that they state the main features, in this case a cyclic flow of electrons from and back to PS1 generating some ATP.

(c) Red algae are aquatic protoctists that are multicellular. The cells of red algae have chloroplasts containing photosynthetic pigments. Many red algae live in deep water.

Two of the accessory pigments of red algae chloroplasts are:
- phycoerythrin (appears red), often present in large concentrations
- phycocyanin (appears blue).

The first few metres of water nearest the surface absorb the red wavelengths of light. If the water also contains particles of organic material it absorbs blue wavelengths.

Fig. 2.1 shows absorption spectra of some pigments in red algae chloroplasts.

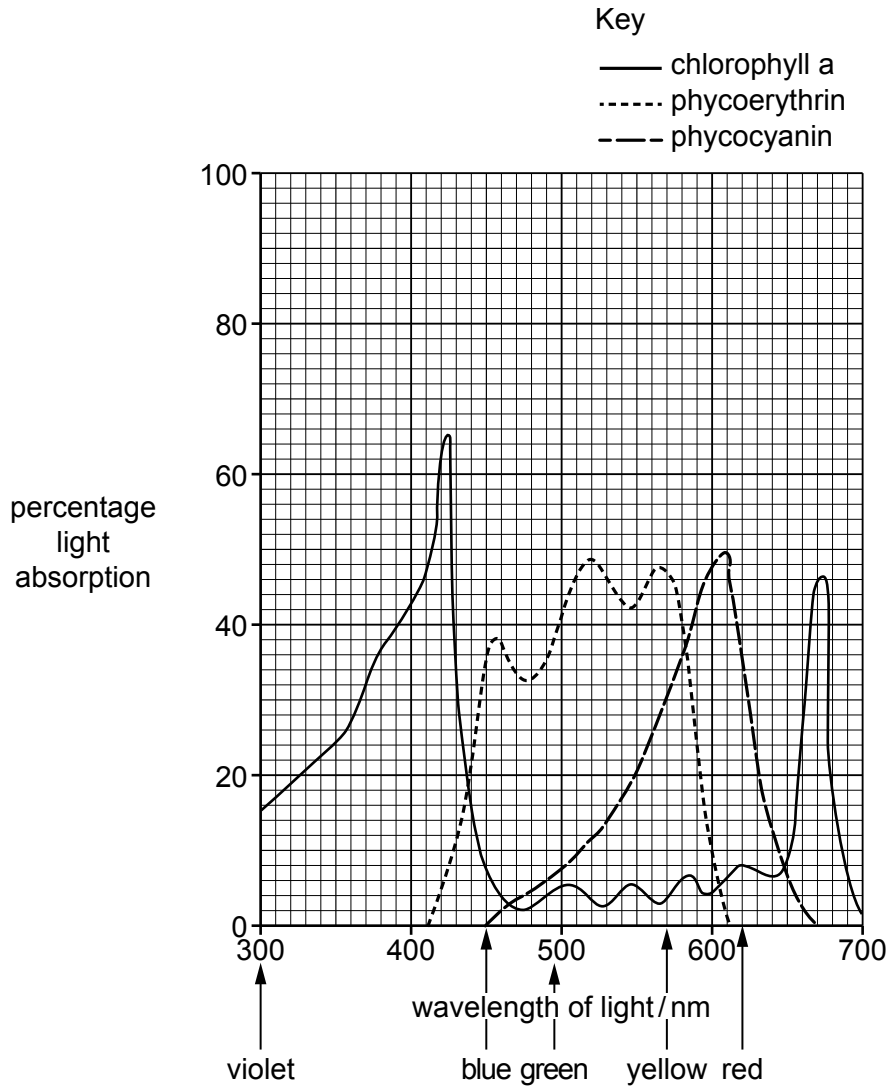

Fig. 2.1

Describe the differences in the absorption spectra of the three photosynthetic pigments shown in Fig. 2.1 **and** explain how these differences help red algae to survive in deep water.

Chlorophyll a absorbs some light over a large range of wavelengths (300–700 nm) but with peak absorption at red and blue light wavelengths and very little absorption of yellow and green light. Phycoerythrin absorbs a smaller range of wavelengths (mostly from 440–590 nm) so it absorbs mainly blue, green and yellow light. Phycocyanin absorbs best at 610 nm and it absorbs yellow and red light best. These differences help red algae survive because phycoerythrin and phycocyanin are accessory pigments that absorb wavelengths of light that chlorophyll a does not absorb well (green and yellow). This is important because the red algae live in deep water where the light that reaches them is mostly green and yellow. So the algae can use the extra pigments to harvest more available light and photosynthesise more and make more glucose for growth.

..... [7]

Examiner comment

- Many candidates tried to give ranges of wavelengths absorbed by a pigment that did not show a consistent minimum percentage absorption. To quote a range with a consistent minimum percentage absorption, a horizontal line should be drawn across the graph at the chosen minimum percentage absorption (20 % and 40 % were commonly chosen). The wavelength values on the x-axis can then be read off to an accuracy of the nearest half a square at each point where the horizontal line crosses the plotted curve.
- Some candidates confused light wavelengths, i.e. the colours of the light available, with light intensity, i.e. how much light penetrated to the deep water where the algae live.
- Responses to this question needed to be comparative, stating that the three pigments in combination allowed **more** photosynthesis than would be the case if the algae had only a single pigment (e.g. chlorophyll a).

Question 3

3 Respiration is a process that results in the synthesis of ATP. The ATP can be used within the cell for energy-requiring reactions and processes.

There are four stages in aerobic respiration: glycolysis, the link reaction, the Krebs cycle and oxidative phosphorylation.

(a) The ATP synthesised in respiration can be used to make larger and more complex biological molecules from smaller molecules.

Name the type of reaction that occurs when larger more complex biological molecules are made from smaller molecules.

anabolic ..... [1]

(b) The first part of glycolysis uses ATP.

Explain why ATP is needed in the first part of glycolysis.

ATP is needed in the first part of glycolysis to add a phosphate group (phosphorylate) to glucose. This activates the glucose and stops it leaving the cell.

..... [2]

(c) State the precise locations of substrate-linked phosphorylation reactions in aerobic respiration.

Locations are the cytoplasm and the mitochondrial matrix. the cell.

..... [1]

(d) Explain what happens to pyruvate in the link reaction in aerobic respiration.

In the link reaction pyruvate gets decarboxylated (loses CO_2) and dehydrogenated (hydrogen atoms are removed and used to reduce NAD). This leaves a two-carbon fragment called acetate which joins to coenzyme A to form acetyl coenzyme A.

..... [2]

(e) Chemiosmosis is a process that occurs in mitochondria during aerobic respiration and in chloroplasts during photosynthesis.

Describe the differences between the process of chemiosmosis in mitochondria and the process of chemiosmosis in chloroplasts.

Differences are:

1 – Chemiosmosis occurs at the inner mitochondrial membrane in mitochondria and at the thylakoid membrane in chloroplasts.

2 – In the mitochondrion, the electrons for the electron transport chain come from reduced NAD (and reduced FAD) but in the chloroplast they come from photolysis of water (non-cyclic) or photosystem 1 (cyclic).

3 – Electron flow and chemiosmosis make ATP in a process called oxidative phosphorylation in mitochondria and photophosphorylation in chloroplasts. [3]

[Total: 9]

Examiner comment

- The model answer correctly lists differences, but also mentions similarities (both make ATP, involve electron flow and use chemiosmosis) in passing in point 3.
- For each point a clear difference is stated between mitochondria and chloroplasts. The answer is expressed as contrasting equivalent points such as the locations in (1), the sources of electrons in (2) and the names of the processes in (3).

Question 4

4 In 1973 a technique for genetic engineering was used for the first time. Recombinant DNA was made using a plasmid and this was successfully transferred into an organism.

In 2012 a new technique for genetic engineering, called gene editing, was developed.

(a) Table 4.1 lists some statements about the two genetic engineering techniques.

Complete Table 4.1 to compare the original genetic engineering technique using a plasmid vector with the newer technique of gene editing. For each row, place a tick (✓) in the correct column if the statement applies and leave a blank if the statement does not apply.

Table 4.1

statement	genetic engineering using a plasmid	gene editing
It can produce a transgenic organism.	✓	✓
It can modify the characteristics of an organism.	✓	✓
It can delete unwanted DNA.		✓
It uses an enzyme that cuts DNA.	✓	✓
It can use RNA to precisely locate the target gene.		✓

[5]

Examiner comment

Candidates who were awarded 4 marks often did not realise that gene editing can produce a transgenic organism.

(b) Orange trees, *Citrus sinensis*, produce fruits that are an important food crop. The functional leaf area of orange trees may be reduced by the growth of citrus canker bacteria. These bacteria cause citrus canker disease.

Scientists used gene editing to develop two types of orange tree with different mutations (changes to the DNA). The mutant orange tree leaves showed resistance to citrus canker disease.

Fig. 4.1 shows the area of leaf with citrus canker disease in wild type (not gene edited) and gene edited orange tree leaves after they have been exposed to citrus canker bacteria.

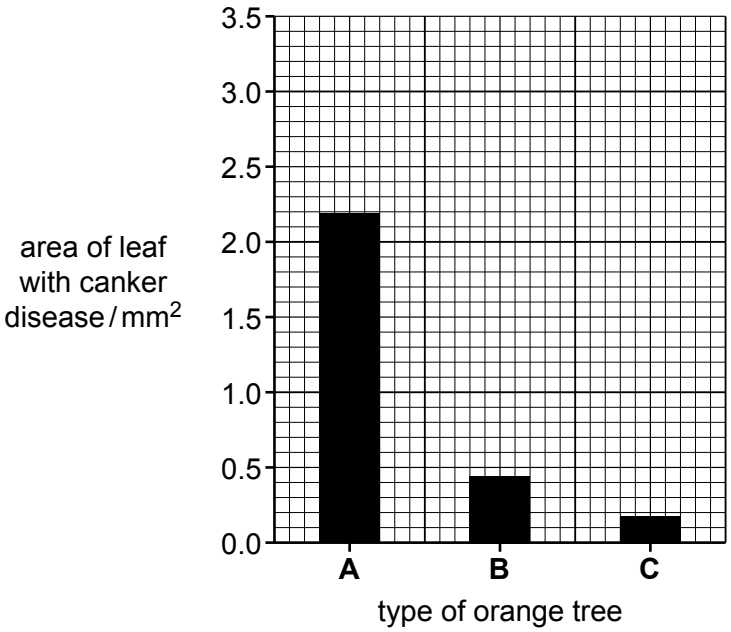

Fig. 4.1

(i) Identify the letter that represents the wild type orange trees on Fig. 4.1.

A ..... [1]

(ii) Explain the social benefits of this example of gene editing.

The benefits are that there is a higher yield of oranges so the farmer makes more money and oranges may become cheaper for people to buy. Also the farmer will not need to spray the orange trees with chemicals to control the citrus canker disease. ..... [3]

Examiner comment

- Candidates often made vague generalisations about economic benefits without applying the general idea to the specific context of the question to develop explanations. In this example, reasons are given to explain why the farmer has more money (as the farmer has more fruit to sell or spends less on chemicals) and why the price consumers have to pay for the fruit falls (greater supply of oranges).
- A common error was to call these antibacterial chemicals 'herbicides' (which only kill weeds) or 'insecticides' (which kill insects). As the chemicals target the bacteria that cause citrus canker disease, correct names would be antibiotics or just pesticides in general.

Question 5

5 Two subspecies of reindeer, *Rangifer tarandus*, live in North America. Members of the different subspecies belong to the same species but have some morphological differences and are found in different geographical locations.

Fig. 5.1 shows a reindeer.

Fig. 5.1

Table 5.1 compares the features of the two North American reindeer subspecies.

Table 5.1

feature	**woodland subspecies, *R. tarandus caribou***	**barren ground subspecies, *R. tarandus groenlandicus***
habitat	southern woodland (warmer)	northern tundra (colder)
type of food	tree leaves, grass	lichens, moss
summer and winter feeding grounds overlap	yes	no
carry out long migrations	no	yes
body size	large	small
colour of fur	dark	light

(a) During the last ice age an ice sheet separated southern and northern populations of *R. tarandus* in North America.

Explain how this ice sheet affected the evolution of *R. tarandus* to result in the two different subspecies.

The ice sheet divided the reindeer population into two separate populations that could no longer interbreed with each other. Each population experienced different selection pressures and different random mutations would have occurred in each population. Therefore the two populations evolved separately leading towards allopatric speciation although the process was incomplete as they are still just sub-species.

[4]

Examiner comment

- Some candidates incorrectly referred to the newly separated populations as species or subspecies. At the point of separation, evolutionary changes would not yet have occurred.
- This answer stresses that the different mutations are random. They do not occur in a directed fashion due to the selection pressures imposed, as many candidates wrongly suggested.
- Many candidates correctly recognised that 'geographical isolation' had occurred or referred to 'allopatric speciation'. In this model response, it is recognised that allopatric speciation had not yet been completed.

(b) Assess the relative importance of natural selection and genetic drift in producing:

(i) the different colours of fur of the two subspecies of reindeer

Natural selection was the important factor in producing the different fur colours as light fur in the snowy tundra helps camouflage the reindeer against predators.

[2]

Examiner comment

- It was important that candidates did not contradict their choice by also stating genetic drift. Candidates were asked to assess the relative importance so needed to be definite about which of the two factors was the driving force behind each morphological difference.
- A common error was for candidates to write 'prey' when they mean 'predator'.

(ii) the different body sizes of the two subspecies of reindeer.

Genetic drift may have caused the size difference or it may even be environmental due to lack of food on the tundra making the reindeer grow less than the southern reindeer who have more food. There is no selective advantage to being small in the colder area, as a larger surface area to volume ratio will mean that heat is lost faster which is non-adaptive. [2]

Examiner comment

- Most candidates assumed that there must always be a natural selection argument to explain every difference or feature in organisms. As a result, these candidates did not choose drift as the reason, even though they could not identify any relevant selection pressures.
- Many candidates incorrectly thought that genetic drift describes the change in allele frequency after selection operates. Genetic drift is a separate mechanism to the mechanism of natural selection, that also leads to changes in allele frequency.
- Candidates who wrote about surface area to volume ratio often got the relationship wrong, saying that a smaller body has a smaller surface area to volume ratio.

(c) Hybridisation has occurred between individuals of the two subspecies which now live in the area previously covered by the ice sheet.

Comment on how the hybrid populations compare to the pure subspecies in terms of genetic variation and potential to adapt to climate change.

The hybrid population will have more genetic variation as they have alleles from both of the parent subspecies. This means they have more potential to adapt to climate change. [3]

Examiner comment

- As the question asked candidates to compare with the pure subspecies, the difference needed to be a comparative word like more, higher or greater (genetic variation or number of alleles).
- The model answer uses the correct wording of ‘from both of the parent subspecies’, which is subtly different to saying ’from both parents’. The question is asking about the gene pool of the whole hybrid population, not about individual reindeer.
- The answer needed to be comparative – a higher likelihood of adapting – and the adapting should be to a future change. Some candidates wrote that the hybrids are already better adapted, but the question is about the potential to adapt to a future change.

(d) Outline how practical techniques could be used to test the hypothesis that migratory behaviour in reindeer has a genetic basis.

To see the genetic basis we need to extract some DNA (e.g. from blood samples) from reindeer that migrate and those that don't. Then use PCR to amplify the DNA. We could use a technique like electrophoresis and then compare the profiles of the two types of reindeer. Or we could sequence the DNA of each and compare the sequences to see how much they differed.

[3]

Examiner comment

- Most candidate answers did not focus on the genetic basis, but considered how to tell (using ecological techniques) whether or not the reindeer migrated. However, the question states that the northern subspecies migrates and the southern one does not, so candidates could start by assuming that it was only necessary to test the two subspecies.
- The question was an invitation for candidates to apply their knowledge of different techniques in molecular genetics to this scenario.

Question 6

6 **(a)** In mammals, the blood glucose concentration must be maintained within narrow limits so that the body cells can function efficiently.

Name the mechanism by which the blood glucose concentration is maintained within narrow limits.

homeostasis ..... [1]

(b) Glucagon is released by the alpha (α) cells of the pancreas when the blood glucose concentration decreases below the set point.

Fig. 6.1 outlines the response of liver cells to glucagon.

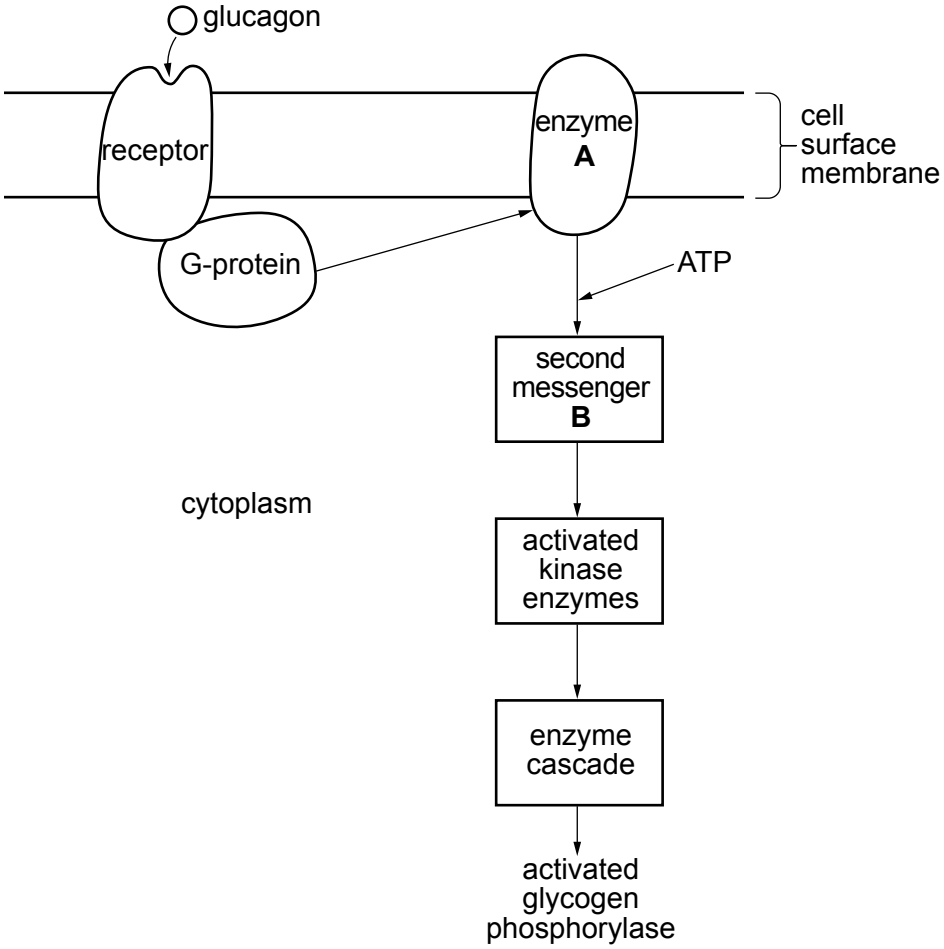

Fig. 6.1

(i) State how glucagon reaches the liver cells.

in the blood ..... [1]

(ii) With reference to Fig. 6.1, name enzyme **A** and second messenger **B**.

A adenyl cyclase

B cyclic AMP

[2]

(iii) State the role of the enzyme cascade.

Its role is to amplify the signal.

[1]

(iv) State the function of the final enzyme in the pathway, glycogen phosphorylase.

To break down glycogen into glucose. [1]

(c) A biosensor is used to measure blood glucose concentration to check that it is within the normal range.

Describe how a glucose biosensor works.

Blood from a pinprick goes onto a pad that is placed into the biosensor. Here glucose oxidase converts any glucose in the blood into the products gluconolactone and hydrogen peroxide. The products result in an electric current flowing and the size of the current is proportional to the concentration of glucose in the blood. A digital reading on the biosensor shows what this concentration is.

[4]

[Total: 10]

Examiner comment

- Many candidates omitted the first step that placed the blood sample onto a pad that is placed in the biosensor.
- Some candidates confused the biosensor with a dip-stick. Dip-sticks involve a chromogen that changes colour.
- Some candidates wrote that a current is applied. The current arises as a result of the reactions involving glucose in the biosensor.

Question 7

7 **(a)** The fruit fly, *Drosophila melanogaster*, usually has red eyes. A gene for eye colour has four alleles: red, apricot, honey and white.

Define the terms *gene* and *allele*.

gene a length of DNA coding for a polypeptide.

.....

allele an alternative form of a gene.

.....

[2]

Examiner comment

- Some candidates specified a sequence of nucleotides, but did not state that they were on DNA (as opposed to RNA).
- The question uses the word 'allele' in the singular, so the answer should match and discuss a single allele. Candidates who used the plural sometimes chose words that changed the sense of their answer, e.g. 'different types of genes' was not acceptable whereas 'a different form of a gene' was acceptable.

(b)
- The allele for red eyes, C^R, is dominant to the other three alleles.
- The allele for apricot eyes, C^A, is dominant to the allele for honey eyes, C^H.
- The allele for white eyes, C^W, is recessive to the other three alleles.

Construct a genetic diagram to show the genotypes, phenotypes and ratio of the offspring from a cross between a fruit fly with red eyes, C^RC^H, and a fruit fly with apricot eyes, C^AC^W.

parents phenotypes	red eyes	apricot eyes
parents genotypes	C^RC^H	C^AC^W
gametes	C^R C^H	C^A C^W
offspring genotypes	C^RC^A C^RC^W	C^HC^A C^HC^W
offspring phenotypes	RED RED	APRICOT HONEY
ratio	2 :	1 : 1

[3]

Examiner comment

The model answer carefully aligns the genetic diagram so that each genotype is matched to its corresponding phenotype and each number in the ratio is matched to its corresponding phenotype.

(c) Describe how you would carry out a test cross **and** use it to determine the genotype of a red-eyed fruit fly.

I would cross the unknown red-eyed fly with a white-eyed fly. If all the offspring had red eyes then the red parent is CRCR. If some have apricot eyes the red parent is CRCA. Similarly some honey-eyed offspring show the red eyed parent's genotype is CRCH or if it is CRCW then we will see a mixture of red and white-eyed offspring.

[3]

[Total: 8]

Examiner comment

Some candidates only identified the test cross partner as homozygous recessive. As three alleles are recessive to red, the test cross partner must be unambiguously identified as a white-eyed fly. Crossing a red-eyed fly with a honey- or apricot-eyed fly will not conclusively reveal the genotype of the red-eyed fly, since the white-eye allele can be masked by the honey-eye allele and also by the apricot-eye allele. This response considers every possibility for the red-eyed parent's genotype and its offspring when crossed with a white-eyed fly.

Question 8

8 **(a)** Over the past 200 years, many species of animals and plants have become extinct.

Fig. 8.1 shows the changes between the years 1800 and 2000 in:
- the number of species becoming extinct
- the size of the world human population.

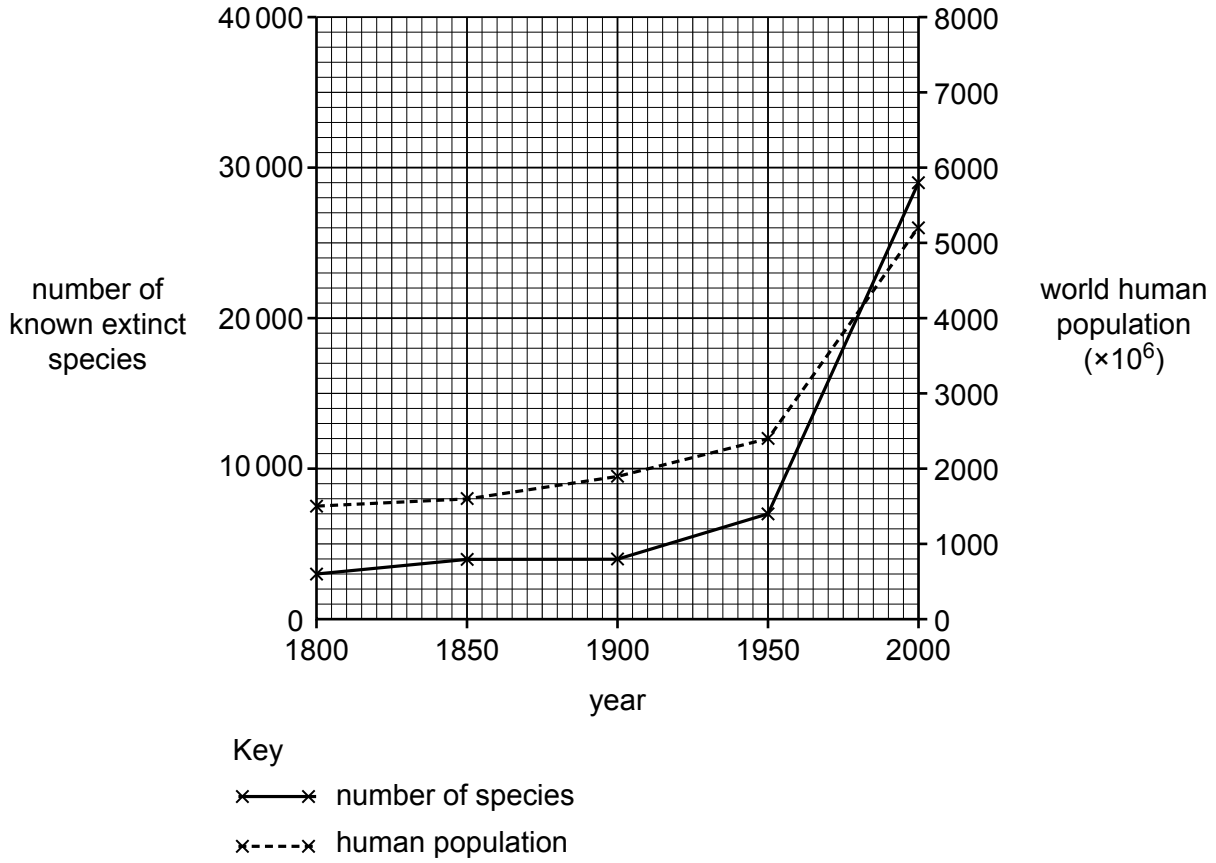

Fig. 8.1

(i) It has been suggested that there is a correlation between the number of species becoming extinct and the size of the world human population.

Suggest reasons for this possible correlation.

Reasons could be that as the world human population increases more habitats are destroyed to make room for towns and farms. Also there could be more hunting of animals and more pollution.

..... [3]

(ii) Calculate the rate of species extinction per year between 1950 and 2000.

Show your working.

$$\frac{29{,}000 - 7{,}000}{50} = 440$$

answer = 440 [2]

Examiner comment

Incorrect responses tended to either use figures from the wrong curve (human population), or used figures that were read off from the wrong y-axis.

(b) Extinction of animal and plant species reduces biodiversity.

Explain why it is important to maintain biodiversity.

It is important to maintain biodiversity because a range of organisms provide us with food, wood for building and different medicines. Biodiversity is interesting and a focus for research and education. Biodiverse habitats are beautiful and enjoyed by people and so these places attract tourists to visit them which provides income for local people. We have a duty to be good stewards of the world and to conserve natural ecosystems so species do not go extinct. Undisturbed forest ecosystems also help to stop soil erosion, absorb carbon dioxide and stabilise the climate. [7]

[Total:12]

Examiner comment

- The first three sentences of the answer score maximum marks, with a focus on the practical value of biodiversity to humans.
- The 'duty to be good stewards…' is the ethical argument, which may be rooted in religious or philosophical beliefs.
- This answer chooses forest ecosystems, but other ecosystems also play a role in the carbon and other mineral cycles, and in stabilising the climate or water cycle.

Question 9

9 (a) Stomata are involved in both transpiration and photosynthesis in plants.

Fig. 9.1 is a diagram of an open stoma, its guard cells and surrounding epidermal cells.

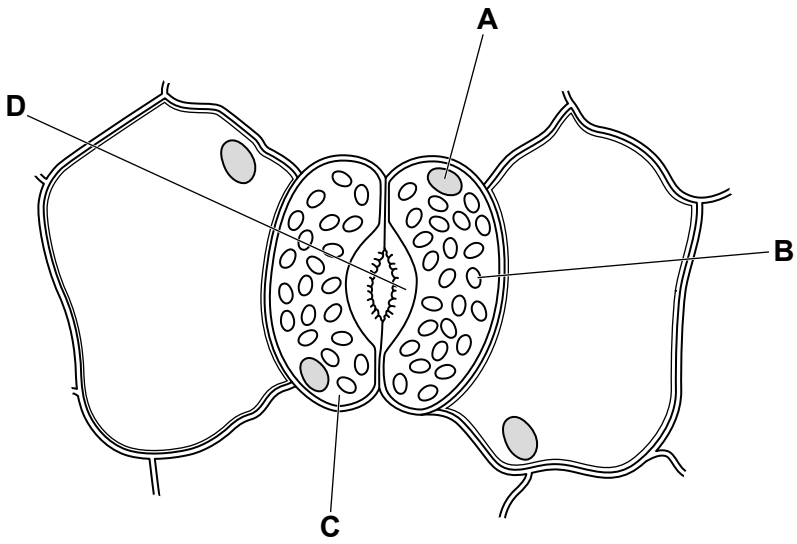

Fig. 9.1

Complete Table 9.1 by choosing the correct letter from Fig. 9.1 to match the feature stated in Table 9.1.

Each letter may be used once, more than once or not at all.

Table 9.1

letter	feature
B	location of Calvin cycle
D	made mainly of cellulose

[2]

(b) The opening and closing of stomata are due to changes in environmental conditions. Hydrogen ions (H^+) and potassium ions (K^+) are involved in the opening of stomata.

Describe how hydrogen ions and potassium ions are involved in the opening of a stoma.

H^+ ions are involved because they are pumped out of the guard cells. This causes K^+ ions to move into the guard cells by facilitated diffusion. This decreases the water potential of the cells, so water enters by osmosis, making the two guard cells expand and causing the stoma between them to open.

..... [4]

[Total: 6]

Examiner comment

- The mechanism by which the hydrogen ions move is stated in this model answer, as is their direction of movement.
- Some candidates did not mention guard cells in their answer.
- The mechanism by which the potassium ions move is also stated, as is their direction of movement.
- This answer makes quite clear the difference between the stoma (hole) and the surrounding guard cells. Fig. 9.1 should have helped candidates with this, but many confused stomata with guard cells.

Question 10

10 (a) Motor neurones and sensory neurones have different roles in nervous coordination.

Contrast the structure **and** function of sensory neurones and motor neurones.

Structure: A sensory neurone consists of an axon and a dendron with the cell body at the point where these two parts meet, while a motor neurone consists of a cell body at one end of a long axon.

Function: Sensory neurones carry impulses from receptors to the CNS while motor neurones carry impulses from the CNS to effectors.

[3]

Examiner comment

The model answer addresses structure and function separately, carefully covering both parts of the question. Differences are stated in the format ‘sensory is like this and motor is like that’.

(b) Mammals have many types of neurones, which vary in axon diameter and myelination.

Table 10.1 shows the axon diameter and mean impulse transmission speed of four different types of mammalian neurone.

Table 10.1

neurone type	myelination	mean axon diameter /μm	mean impulse transmission speed / $m\,s^{-1}$
motor α	✓	13.0–20.0	80–120
motor β	✓	6.0–12.0	35–75
motor δ	✓	1.0–5.0	5–35
motor C	✗	0.2–1.5	0.5–2.0

Using the data shown in Table 10.1, comment on the relationship between:
- myelination and mean impulse transmission speed
- axon diameter and mean impulse transmission speed.

Myelination increases the speed of impulse transmission. The unmyelinated neurone motor C has a top speed of 2 $m\,s^{-1}$ whereas the myelinated neurone δ has a greater speed of 5 to 25 m^{-1}. As the axon diameter increases, so does the speed of impulse transmission.

..... [3]

Examiner comment

- Some candidates compared C and another neurone, but did not state which was myelinated and which was not.
- Figures are quoted with units. For figures to illustrate the effect of axon diameter on impulse transmission speed, units (μm) would also be needed when quoting the diameters of two neurones.

(c) Fig. 10.1 is a graph of an action potential in a mammalian neurone.

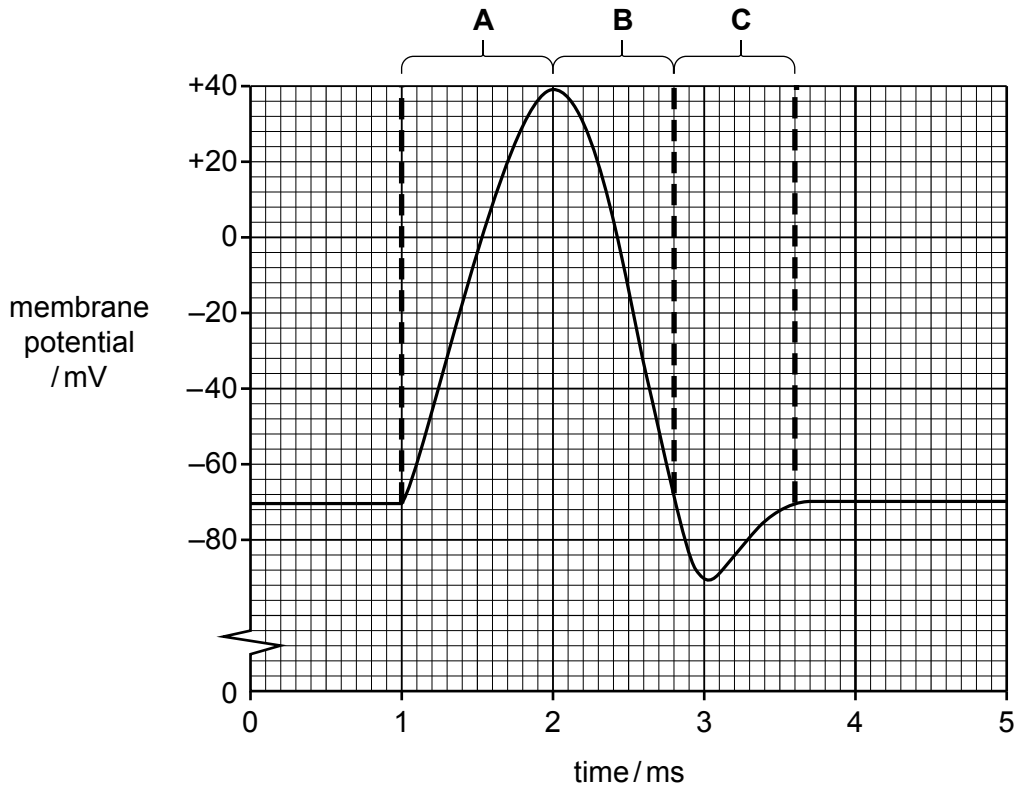

Fig. 10.1

With reference to Fig. 10.1 suggest why:
- no further action potential can occur during **A** and **B**
- it is difficult for a further action potential to occur during **C**.

During A, no action potential can occur because the sodium ion channels are already open and Na+ has already entered.

During B, no action potential can occur because now the potassium ion channels are open so the potential difference is decreasing.

During C, the neurone is hyperpolarised meaning a larger increase in potential difference would be needed to reach the threshold to trigger an action potential. [3]

[Total: 9]

Examiner comment

The model answer deals with each section of the graph in turn, something candidates should try to do.

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