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Examiners' Report
June 2017

GCE Biology 9BI0 01

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Introduction

This summer saw the first paper 1 of the new specification. This paper differed from the papers of the previous specification in a number of ways:

1. New command words.

Candidates need to be taught the meaning of the command words that may be used on a paper; these can be found at the back of the specification. On this paper, marks were lost in question 4(c) because a number of candidates wrote two separate descriptions of embryonic stem cells and iPS cells. Compare and contrast means that similarities and differences should be given as paired statements. The command word 'explain' is going to be seen more, partly because 'suggest' is no longer a command word that can be used. This command word means that the majority of statements made need to be justified.

2. Greater emphasis on application of knowledge.

Candidates need to identify the topic or topics in the specification that are being tested in a particular question and apply what they have been taught to the context of the question.

3. More questions based on data analysis.

Candidates will need to be presented with data in many different formats to practise analysing data in preparation for their examinations.

4. An increase in the percentage of marks allocated to level 2 mathematics skills.

Any of the maths skills can be tested on any of the A level papers, in any context. Assessment of the maths skills is not restricted to where they may appear in the specification; this is explained in the appendix. On this paper the statistics test in question 5 may have caught out a few candidates.

5. Less emphasis in this paper on practical work.

Paper 3 will focus on the practical work. If any is tested in Paper 1, the question will focus on the understanding/application of the techniques and not the methodology to any great extent.

6. Introduction of levels-based questions which replace the 6-mark QWC questions.

These questions will not be AO1 questions and therefore may well involve candidates using more than one source of information and they are going to need to be made aware of this and given practice.

Many teachers and candidates had clearly embraced the challenges of the new specification and the Government changes to the style of assessment. The new content in the specification had been picked up on and taught well.

The increased mathematics content of the paper clearly caused some candidates issues as did the new levels-based questions: there were a number of responses left blank.

Question 1 (c)

This question is on the theme of structure and function of blood, asking for an explanation of why a person would have an unusual proportion of eosinophils. The explanation needed to be where these cells had come from as well as their function.

(c) Blood taken from a patient had an unusually high proportion of eosinophils.

Explain why this patient had an unusually high proportion of eosinophils.

(2)

~~Because there was a pathogen present in~~ ~~the body which triggered~~ the non specific immune response was triggered, and caused a high proportion of eosinophils to be produced because they had an allergic response. so histamine has to be released.

ResultsPlus
Examiner Comments

This candidate realised that eosinophils had to be produced to elevate their numbers in the blood and named one condition that eosinophils are involved in. 2 marks.

Question 2 (b)

This question gave a diagram showing the evolutionary relationship between four animals: cows, pigs, minke whales and dolphins. Candidates were asked to analyse the diagram and explain this evolutionary relationship. Successful candidates should realise that dolphins and minke whales have a common ancestor which evolved from the same common ancestor as cows. In addition, they should spot that pigs were the first animal to diverge and therefore are most distantly related.

The command word in this question was 'explain'. Candidates who only described the common ancestors, without commenting on the evolutionary relationship, could not score more than one mark.

Analyse the diagram to explain the evolutionary relationship between these four animals.

(3)

Dolphins and minke whales are the most closely related, as they have (evolved from) the same common ancestor. Cows are more closely related to dolphins and minke whales than pigs are, as cows and ~~dolphins~~ the ancestor from which both dolphins and minke whales evolved from, have the same common ancestor. Finally, all four animals are related very distantly to eachother, as they all have a distant common ancestor.

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Examiner Comments

This example illustrates our first two mark points.

Analyse the diagram to explain the evolutionary relationship between these four animals.

(3)

Dolphins and minke whales are the most closely related species so have the fewest differences in their DNA. Cows are the next most closely related species to dolphins as they split comes after the common ancestor. Pigs are the most distantly related species as their speciation occured first. Pigs

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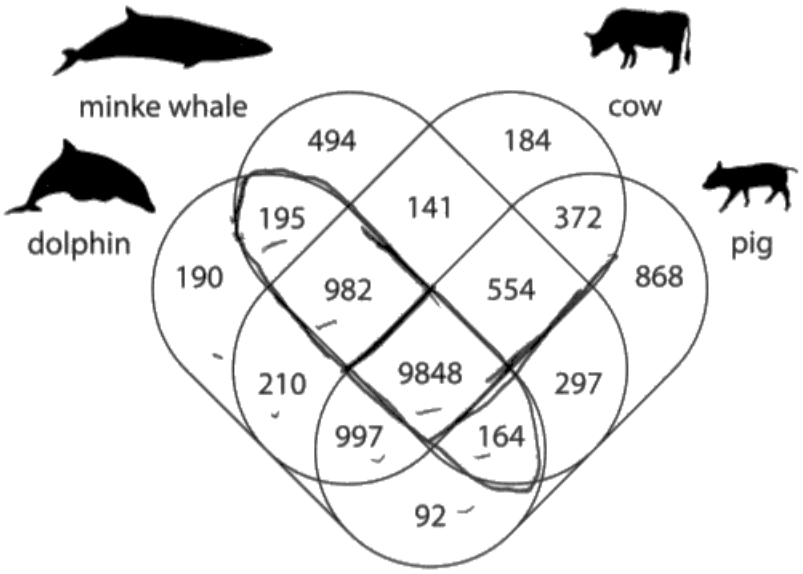
Examiner Comments

The first mark point could not be awarded for the first statement in this response as there is no comment about the common ancestor of the dolphins and the whales. However, the last mark point could be awarded. The third mark point about the pigs is illustrated at the end of the response.

Question 2 (c)

A number of candidates could interpret the Venn diagram and calculated the percentage to a sensible number of decimal places.

(c) The Venn diagram shows unique and shared gene families in the genomes of minke whales, dolphins, pigs and cows.



Calculate the percentage of a dolphin's gene families that are shared with the minke whale.

(2)

Total no. of genes = 12678

Total no. m.W. genes = 11189

% shared = $\left(\frac{11189}{12678}\right) \times 100$

= 88.3 %

Answer 88.3 %

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Examiner Comments

This candidate laid out their calculation clearly and correctly rounded their answer to one decimal place. 2 marks

ResultsPlus
Examiner Tip

You do not have to show your working to be awarded full marks for a correct answer. However it is safer to do so as you may still score some marks even if you make a mistake in your calculation.

Question 2 (d)

Candidates were able to define the term 'species' for the first mark point; this could be awarded even if they did not put it in the context of the dolphins and whales. The second mark point could only be awarded if it referred to the wholphin.

(d) A wholphin is an extremely rare hybrid animal born from the mating of a female dolphin and a male killer whale.

Kekaimalu was a wholphin born in the United States in 1985. Kekaimalu was mated with a dolphin and on three occasions gave birth to live offspring.

Explain how this case study illustrates the limitations of the definition of a species.

(2)

The definition of a species is something that can reproduce to produce fertile offspring. This case study shows the limitations of this definition because the majority of the time two organisms from different species cannot reproduce to produce fertile offspring whereas in this case they have produced fertile offspring.

ResultsPlus
Examiner Comments

The first mark point was not awarded on the first line as 'something' is too vague. However both marks could be awarded at the end of the response.

ResultsPlus
Examiner Tip

Read the question carefully and ensure that you use the context of the question in your answer if instructed to do so.

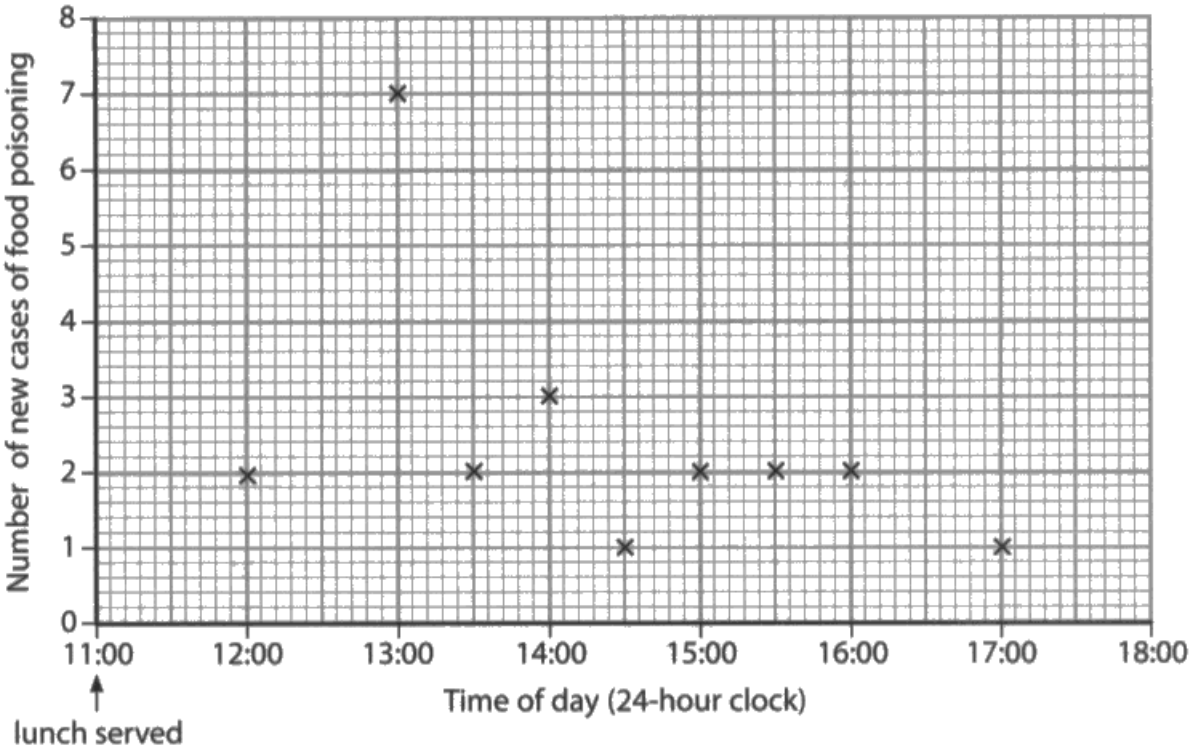
Question 3 (a) (i)

The specification does not require candidates to know specific details about conditions that exotoxins and endotoxins are responsible for. Therefore there were no marks allocated for knowledge about food poisoning per se. This question was testing the candidates' understanding of the differences between the two types of toxin and the examples given in the specification of bacteria that produce each type of toxin.

3 Food poisoning can be caused by food that is contaminated with pathogenic microorganisms.

(a) A number of different bacteria can cause food poisoning.

The graph shows the number of new cases of food poisoning after a lunch party.



(i) Explain why it is likely that this food poisoning resulted from food contaminated with *Staphylococcus* rather than with *Salmonella*.

(3)

• Staphylococcus is gram positive bacteria that releases exotoxins that travel into the blood stream and have an immediate affect (2 hours after lunch served, new cases observed which means symptoms seen).

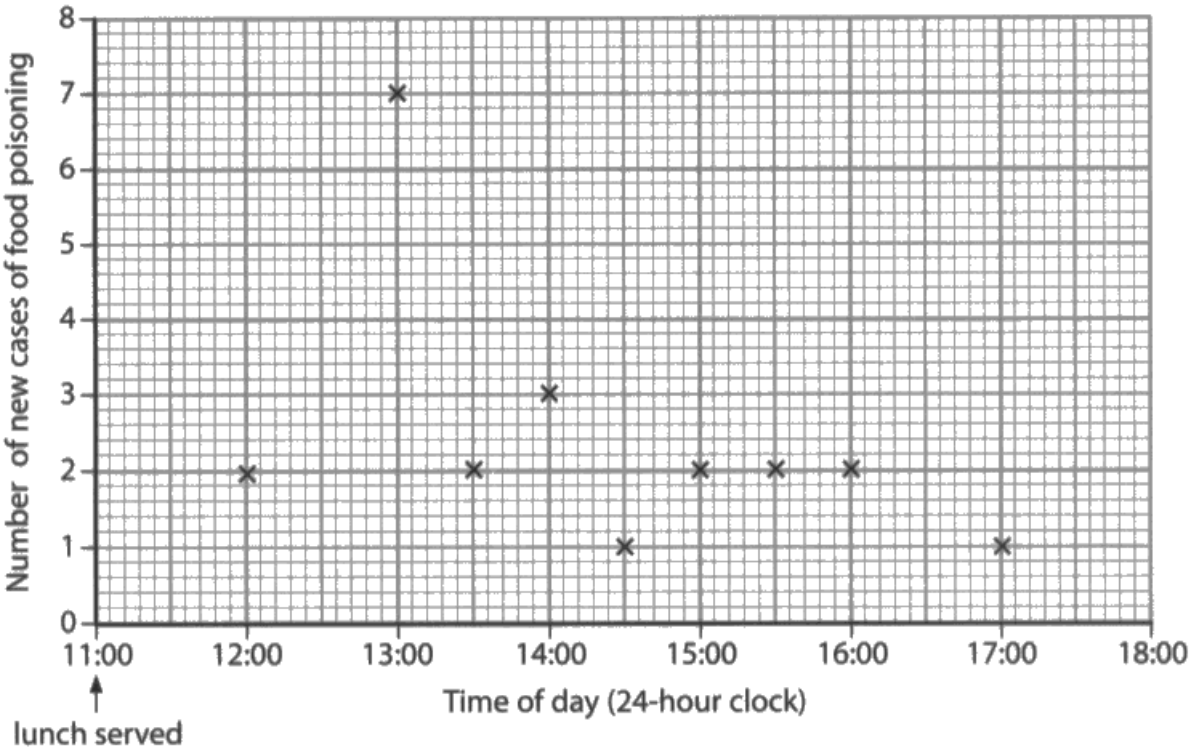
• Salmonella is gram negative bacteria that releases endotoxins but only once the host cell digests the cell (because endotoxins are in lipopolysaccharide layer). This means time taken to absence symptoms would be longer ∴ longer time for new case of food poisoning.

ResultsPlus
Examiner Comments

This response illustrates all our mark points.

ResultsPlus
Examiner Tip

If you are given data in either a table or a graph with a question, ensure that you refer to it.



(i) Explain why it is likely that this food poisoning resulted from food contaminated with *Staphylococcus* rather than with *Salmonella*.

(3)

The number of cases at 13:00 is 7 while at every other hour the number does not rise above 3 cases. This suggests that the food poisoning was caused by external bacteria which lasts a few hours where Salmonella would cause symptoms over 2-3 days and symptoms would be exhibited much later.

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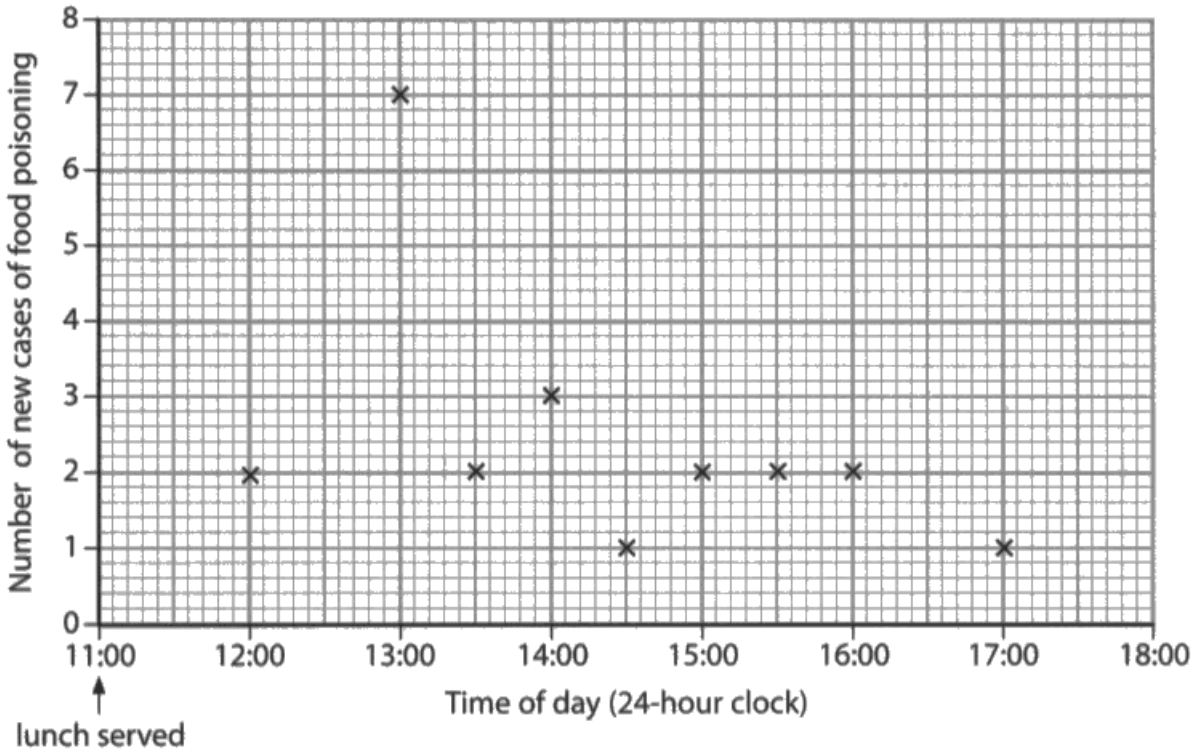
Examiner Comments

The first sentence is only describing some of the data without drawing a conclusion from it. The rest of the response is using knowledge that has been taught about food poisoning. 0 marks



(i) Explain why it is likely that this food poisoning resulted from food contaminated with *Staphylococcus* rather than with *Salmonella*.

(3)

Staphylococcus bacteria cause symptoms faster than Salmonella bacteria as they produce exotoxins that quickly provoke an immune response & damage the patient, whereas the endotoxins in Salmonella's cell membranes are only released after lysis, which the latter or which takes longer to occur & cause symptoms than the former

ResultsPlus
Examiner Comments

This candidate did not refer to the information in the graph in their response which is why they could not be awarded our first mark point.

Question 4 (a)

The command word in this question is 'explain', so candidates were expected to give a reason why an increase in age increased the incidence of heart disease and why the incidence is gender-related.

4 Scientists are developing ways of using stem cells to replace heart cells that have been damaged as a result of heart disease.

(a) The table shows the results of a survey of the incidence of heart disease.

Age / years	Incidence of heart disease per 1000 population	
	In women	In men
18 to 44	3	5
45 to 64	118	138
65 to 74	220	305
75 and older	358	422

Analyse the data to explain the factors affecting the incidence of heart disease.

(2)

As age increases, the incidence of heart disease increases (blood pressure increases and arteries became less elastic). men are more at risk at developing heart disease than women who are of the same age as oestrogen in women prevents clot formation in arteries (atherosclerosis)

ResultsPlus
Examiner Comments

This response is a good illustration of all our mark points.

ResultsPlus
Examiner Tip

In a question where you are asked to 'analyse the data to explain' you should describe what the data is showing and then say 'because...'
As the data is showing two factors, age and gender, you need to describe each factor and then say why each factor is having an effect.

Question 3 (a) (ii)

There are four possible techniques that candidates could be expected to know about for identifying the bacteria and we did see each of the techniques described. However candidates tended to describe one technique in detail instead of describing several techniques in less detail.

(ii) Describe the techniques microbiologists could use to confirm that this food poisoning was caused by *Staphylococcus*.

(4)

Microbiologist can use a streak plate with the sample being taken from the food onto a agar plate which has Salmonella antibiotics on it and if the pathogen survived we would have to test it on a staphylococcus agar plate with it's antibiotic on to see if it dies to Confirm it's Staphylococcus. Also just letting the sample or broth including the food microbes grow could let us see what's there, also using streaking different Colonies could be identified by Colour, Shape or physical characteristics

ResultsPlus
Examiner Comments

This response is a good illustration of our first mark point and then techniques three and one.

(ii) Describe the techniques microbiologists could use to confirm that this food poisoning was caused by *Staphylococcus*.

(4)

Staphylococcus is a type of gram positive bacteria, which can be treated with antibiotics that ~~prevent~~ inhibit synthesis of the cell wall, ie. Penicillin. Gram positive bacteria appear purple when stained with crystal violet under a microscope. Microbiologists could confirm it was Staphylococcus by either taking a blood sample & staining it with ~~penicillin~~ crystal violet, or by treating it.

ResultsPlus
Examiner Comments

This candidate is describing our second technique. 1 mark.

ResultsPlus
Examiner Tip

Read the question very carefully. This question says 'techniques', plural, which means that you will have to describe at least two to get full marks. Also use the mark allocation to help you work out what is expected of you in your answer. It is unlikely that you will score four marks for simply describing one or two techniques.

Question 4 (b)

Many candidates wrote about an atheroma or a clot blocking the coronary artery, but only in the better responses did they extend the answer to explain why the blockage caused the heart disease.

(b) Explain why heart cells are damaged as a result of heart disease.

(2)

heart disease causes blockz arteries (atherosclerosis), if this happens in a coronary artery, then no blood can pass through which means no O2 for cardiac cells, so they can't respire and die (myocardial infarction) because they can't respire anaerobically.

ResultsPlus
Examiner Comments

This response illustrates all three of our mark points as we were happy to accept that atherosclerosis results in the blocking of the arteries.

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Examiner Tip

Use the mark allocation to help you decide how much to write. If you just state that an atheroma blocks an artery you have only given one piece of information and therefore will not be awarded more than one mark. There were two marks available so you must have been expected to extend your answer to say how the block causes the heart disease.

Question 4 (c)

'Compare and contrast' is a new command word in this specification, meaning that both similarities and differences should be given, and we are expecting the similarities and differences to be given in pairs; (as in the previous specification, when we used the command word 'compare'.) Many candidates wrote about embryonic stem cells and then wrote about the iPS cells.

(c) Both embryonic stem cells and induced pluripotent stem cells (iPS cells) can be used to create new heart cells.

Compare and contrast the properties and uses of embryonic stem cells with those of iPS cells.

(5)

• Embryonic stem cells are ~~made~~ taken from a fertilised egg cell (IVF, not in body), the embryo is allowed to grow untill it forms (128 cells) a blastocyst. The inner cell mass of a blastocyst has cells that are pluripotent. These cells are not a patients own, there could be rejection by the body so immunosuppresant drugs required. Also, this can be deemed unethical because embryo's can't give consent. Some people also believe life starts at conception

• IPS cells are made by taking a fibroblast (from person) and inserting 4 specific genes using a viral vector (oct 4, sox 2, ~~klf~~ klf 4, ~~cMyc~~ cMyc). These are a persons own cells (fibroblast is persons own cell) so no immune rejections, ~~and~~ and no ethical issues either however, the 4 genes may promote cancer growth.

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Examiner Comments

This is an example of a candidate who wrote about each type of cell separately. 0 marks.

ResultsPlus
Examiner Tip

In a 'compare and contrast' question you must write about both aspects in one statement.
This candidate has written a response that would answer the question, "Describe the properties and uses of embryonic stem cells and iPS cells."

(c) Both embryonic stem cells and induced pluripotent stem cells (iPS cells) can be used to create new heart cells.

Compare and contrast the properties and uses of embryonic stem cells with those of iPS cells.

(5)

Embryonic Stem cells have the ability to differentiate into any type of cell including the placenta and the umbilical cord. IPS cells are able to do this as well but cannot differentiate into the placenta and umbilical cord. IPs cells are useful in that they can be made, and given to an individual in order to replace dysfunctional cells such as the damaged heart cells. The individual will not need immune suppressing drugs as the cells would have originally come from them. This makes them advantageous. Embryonic stem cells must be obtained from embryos which is seen as unethical and is less favoured and used as a result. This make IPS cell a better option to use.

ResultsPlus
Examiner Comments

This candidate has given us one similarity (our second one) and one difference (our third one). 2 marks.

ResultsPlus
Examiner Tip

Use the mark allocation to help you structure your answer. As there are five marks available then you must write about five aspects. As the command word is 'compare and contrast' you must write about at least one difference and one similarity.

(c) Both embryonic stem cells and induced pluripotent stem cells (iPS cells) can be used to create new heart cells.

Compare and contrast the properties and uses of embryonic stem cells with those of iPS cells.

(5)

Embryonic Stem cells are totipotent and are capable of becoming any specialised cell where as iPS cells are only pluripotent so can only become certain specialised cells. Embryonic cells are hard to obtain due to the ethical problems surrounding them where as iPS cells are easier to obtain as they can be taken from consenting adults. Embryonic cells are also derived from ~~are~~ embryos in the first stages of fertilisation where as iPS cells are taken from adult bone marrow. Because of this iPS cells are less likely to be rejected as they are taken and made from the hosts cells compared to embryonic stem cells which are not related to the host. Although iPS cells are harder to understand in terms of their pluripotency as only a few of the specialising they can do have been found compared to how many they are capable of. As well as this iPS cells ~~are~~ although useful the two of the genes used to cause them to specialise have also been found to be oncogenes which are cancer causing ~~ge~~.

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Examiner Comments

This is an example of one of the better responses, with one similarity and two differences given. 3 marks.

Question 5 (a) (ii)

Including statistics tests in a written paper is new to this specification and many candidates coped well with this calculation.

(ii) The student analysed the data using the formula:

$$r_s = 1 - \frac{6\sum d^2}{n(n^2 - 1)}$$

The student calculated $\sum d^2$ to be 108.

Use the formula to calculate r_s.

(3)

$r_S = 1 - \frac{6(108)}{7(7^2-1)}$

$= -0.929$

Answer -0.929

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Examiner Comments

This was a clearly laid out calculation with the answer given to a sensible number of decimal places and gained full marks.

r_s = [illegible] 1 − 648

Answer .....

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Examiner Comments

This candidate was awarded the first mark point only, for correctly calculating the numerator.

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Examiner Tip

It is always worth attempting a calculation even if you cannot complete it; you may pick up some of the method marks.

$$r_s = 1 - \frac{108}{7(7^2-1)} = 1 - 4\frac{108}{336} = 1 - 0.3214285714$$
$$= 0.68$$

Answer 0.68

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Examiner Comments

This is an example where the candidate made an error in calculating the numerator but still scored two marks.

ResultsPlus
Examiner Tip

If you clearly lay out your working and show individual component calculations, you can still get the majority of marks even if you have made a mistake somewhere.

Question 5 (a) (iii)

This question needed to be read carefully for both marks to be awarded.

(iii) Explain how the student should use the r_s value calculated in (a)(ii) to find the strength of the relationship between these two variables.

(2)

She should use this r_s value and find the critical value at a 5% significance level with 6 degrees of freedom and see if the r_s value is greater than the critical value. If it is, she can conclude that there is a statistically significant negative correlation between water temperature and solubility of water.

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Examiner Comments

This is an example of the type of response we were hoping to see. 2 marks.

(iii) Explain how the student should use the r_s value calculated in (a)(ii) to find the strength of the relationship between these two variables.

(2)

The value shows a very strong negative correlation. They should compare it to the critical value for $n = 7$ at the 95% confidence level (5% significance) and if the r_s value is greater than the critical value then the correlation is statistically significant.

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Examiner Comments

For the first mark point we were happy to accept an answer that referred to 5% significance level as seen in the previous response, or 95% confidence level. This candidate has expressed their answer both ways to be on the safe side.

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Examiner Tip

If you are going to give an alternative in an answer then both must be correct; the examiner cannot choose which answer to accept.

Question 5 (b)

Most students were awarded our first mark point. The better responses discussed either the oxygen availability or the temperature but rarely both.

(b) Explain why the student chose to keep these two species of fish in an aquarium at 30°C.
(4)

30°C is above the minimum temperature, so both species of fish will be able to survive comfortably in the same tank. Also, the concentration of O_2 at this temperature is 7.7 $mgdm^{-3}$, which is greater than the minimum required by the other species. Therefore at this temperature, both species can be kept in the same tank and will have their requirements met. If the temp. were any higher, the O_2 conc. would decrease too low for the other species to survive - 5.9 $mgdm^{-3}$ at 50°C, for example, and if the temperature were any lower, despite the O_2 conc. increasing, it would fall too low for the fish species to survive. As water temperature increases, the general trend is for O_2 solubility to decrease. Therefore a balance between these two variables that allows both species to survive must be met.

(Total for Question 5 = 10 marks)

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Examiner Comments

This response illustrates our first two mark points.

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Examiner Tip

The data gave information about oxygen availability and temperature so the importance of each to the fish should be discussed if full marks are to be awarded.

Question 6 (a) (i)

Candidates described the data but very few used their own knowledge of chloroplast and mitochondrial function to answer the question.

6 Mitochondria and chloroplasts in eukaryotic cells are thought to have originated millions of years ago by a process called endosymbiosis.

In endosymbiosis, free-living prokaryotic organisms were engulfed by their new host cells.

(a) The table shows the lipid composition of the membranes of these two organelles.

Type of lipid	Percentage of total lipid composition of membranes (%)	
	In mitochondria	In chloroplasts
phosphatidyl A	43	0
phosphatidyl B	35	0
phosphatidyl C	6	1
phosphatidyl D	3	7
phosphatidyl E	13	0
monogalactosyldiacylglycerol F	0	55
digalactosyldiacylglycerol G	0	24
sulfolipid H	0	8

(i) Analyse the data and use your knowledge to explain why these two organelles are thought to have originated from different prokaryotic organisms.

(3)

Of the 8 lipid types, only 2 of them are present in both mitochondria and chloroplasts, and only in very low numbers. Generally, lipid composition of mitochondria and chloroplasts is very different and do not contain many of the same lipids. Also, chloroplasts contain starch granules whereas mitochondria may contain glycogen stores. Mitochondria also have many ~~thistae~~ cristae whereas chloroplasts contain grana.

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Examiner Comments

This candidate did attempt to use some of their own knowledge but did not pick up on the fact that the question was about membranes and their involvement in the organelles' function. 2 marks.

These two organelles have different types of lipids in the membrane, this shows that they have different structures and so couldn't have originated from the same prokaryotic organism. Furthermore mitochondria and chloroplasts have two very different functions, the mitochondria is used for cellular respiration whereas chloroplasts are used in photosynthesis. The uses are so different that the they cannot have originated from the same prokaryotic organism.

ResultsPlus
Examiner Comments

A response that did pick up two of the marks.

ResultsPlus
Examiner Tip

If you want to access full marks you must address all components of the question.

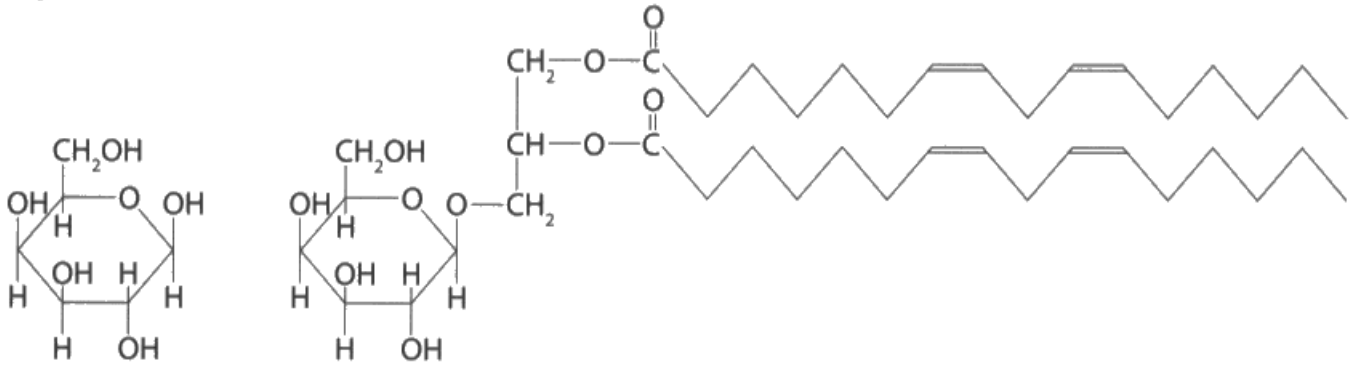
Question 6 (a) (ii)

A wide range of diagrams was seen for this item. Many candidates knew what a glycosidic bond looked like and that water was formed during the condensation reaction.

(ii) Digalactosyldiacylglycerol (DGDG) is synthesised from galactose and monogalactosyldiacylglycerol (MGDG).

The galactose forms a 1,6 glycosidic bond with the MGDG.

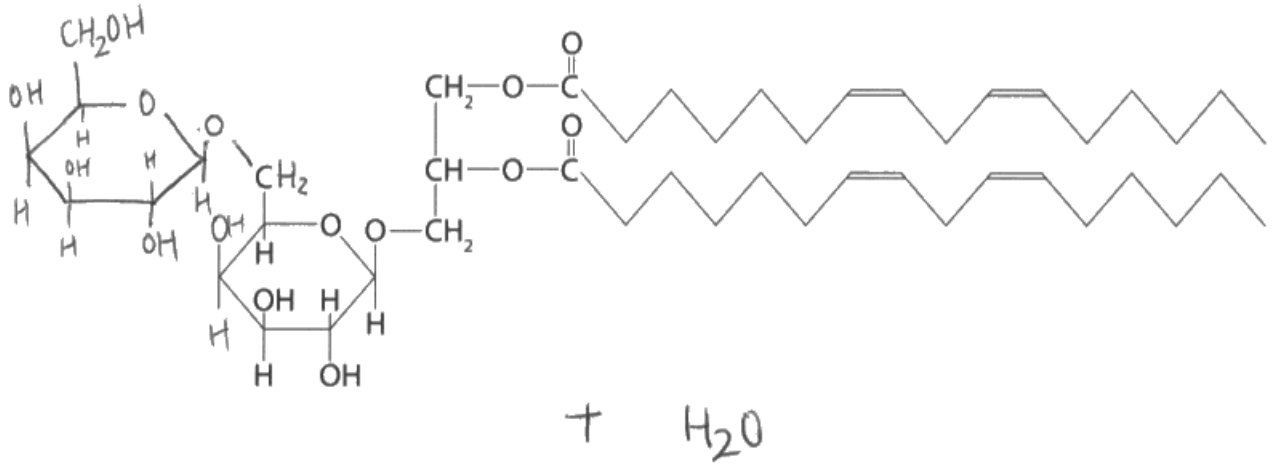
The diagram shows the structure of galactose and MGDG.



galactose MGDG

Complete the diagram below to show the structures of the products formed when DGDG is synthesised from galactose and MGDG.

(3)



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Examiner Comments

We did see some drawings that scored full marks.

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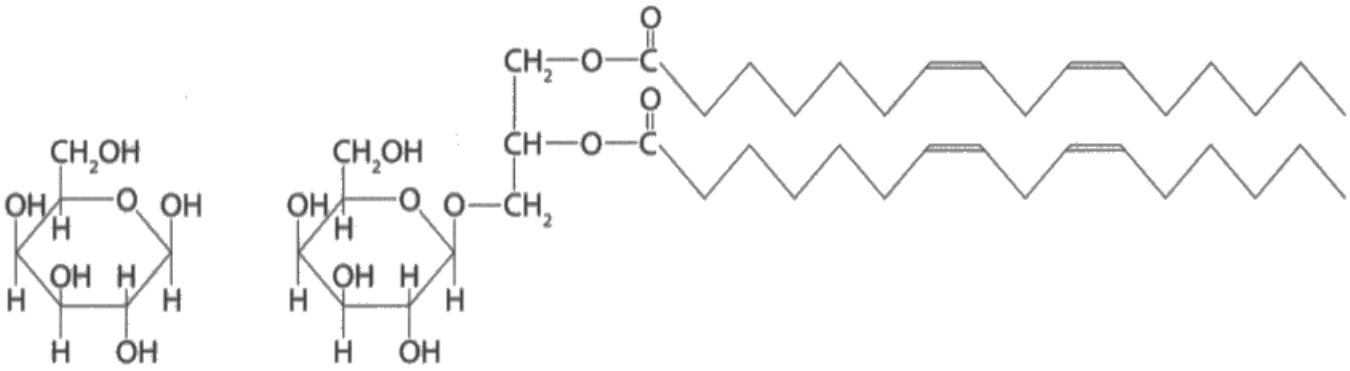
Examiner Tip

Take care when drawing or completing diagrams; they need to be accurately done. This would apply to graphs as well.

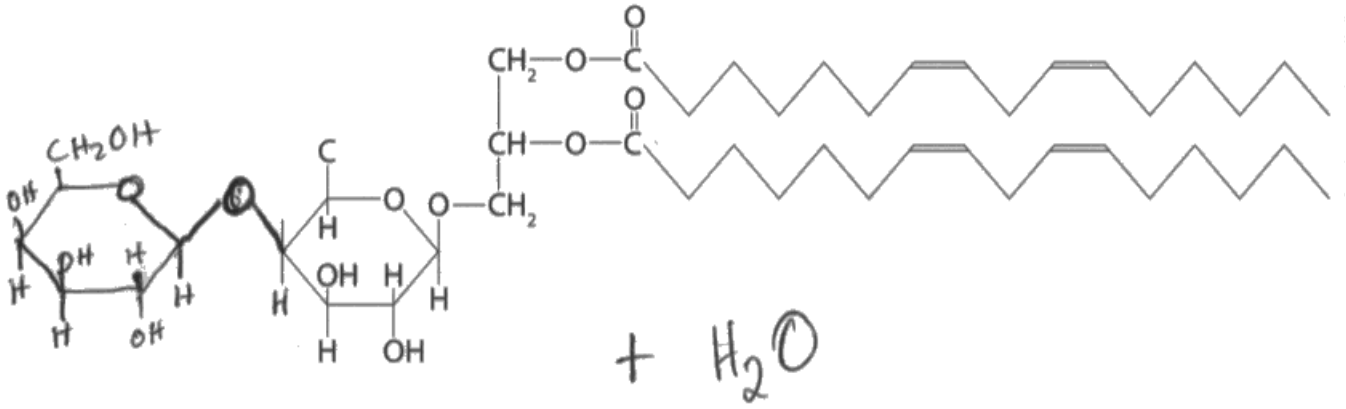


galactose

MGDG

Complete the diagram below to show the structures of the products formed when DGDG is synthesised from galactose and MGDG.

(3)



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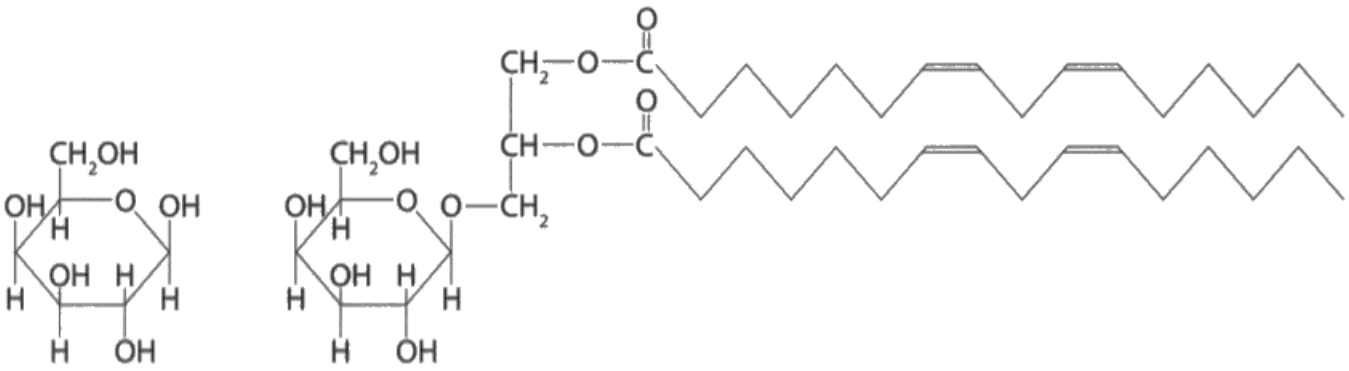
Examiner Comments

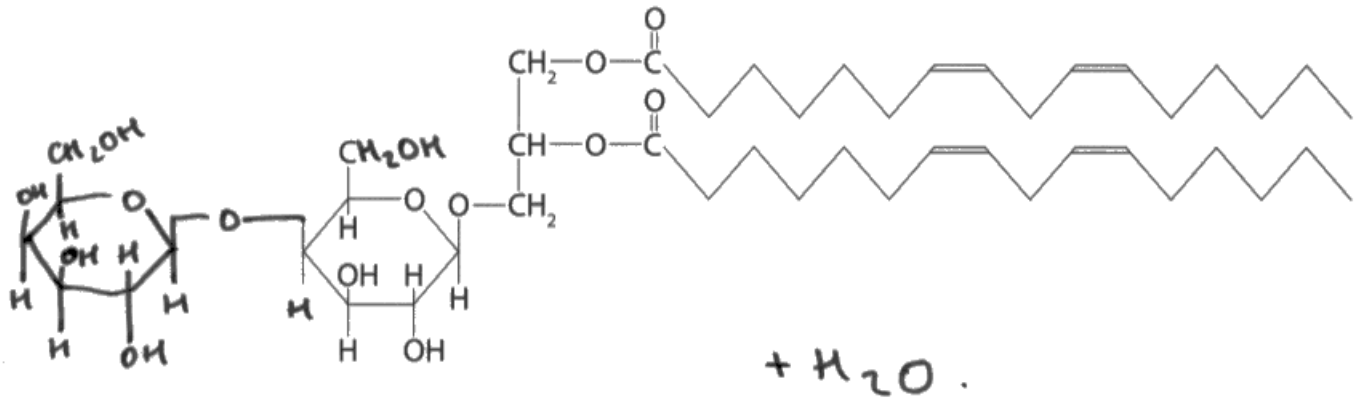
This was probably the commonest response: the glycosidic bond drawn between the C1 and C4 and the rest of the molecule not completed, scoring only the water mark point.



galactose MGDG

Complete the diagram below to show the structures of the products formed when DGDG is synthesised from galactose and MGDG.

(3)



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Examiner Comments

Candidates who drew their glycosidic bond between C1 and C4 could still score two out of the three marks if they completed their diagram correctly.

Question 6 (b) (i)

This item did not cause too many candidates a problem.

(b) Chloroplasts are thought to be derived from cyanobacteria.

It is estimated that there are 1×10^{10} carbon atoms in one cyanobacterial cell.

Ten photons of light are needed to fix one carbon atom.

(i) Calculate the number of photons of light needed to fix enough carbon to form one cyanobacterial cell.

(1)

1×10^{11}

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Examiner Comments
Most candidates selected to answer this question in the format seen here, scoring the mark.

Question 6 (b) (ii)

All reasons given in the mark scheme for the value being an underestimate were seen. Few candidates used the mark allocation as a prompt to give more than one explanation.

(ii) Explain why the value calculated in (b)(i) is likely to be an underestimate.

(2)

because there may be more than 10 photons of light needed to fix one carbon atom or more than 1×10^{10} carbon atoms in one cyanobacterial cell as not all can be seen.

ResultsPlus
Examiner Comments
An illustration of our first mark point. 1 mark.

(ii) Explain why the value calculated in (b)(i) is likely to be an underestimate.

(2)

not all photons will have enough energy to fix the carbon as energy is dependent on wavelength. not will all photons be absorbed, some will be reflected.

ResultsPlus
Examiner Comments

Comments about the wavelengths of light and the energy of photons were common.

Question 6 (b) (iii)

A question such as this one was common on the old specification. Most candidates started their account at the second mark point so the first mark point was rarely seen.

(iii) Describe how carbon fixation takes place in chloroplasts.

(3)

In the stroma, of the Calvin cycle occurs. RuBP is reacted with carbon dioxide and is catalysed by Rubisco (enzyme). The carbon fixes RuBP, so the carbon chain increased by one (RuBP is a 5 carbon compound and reacts to produce a 6 carbon compound).

ResultsPlus
Examiner Comments

This was a fairly typical response, scoring 3 marks.

Question 7 (a)

The responses to this question were quite disappointing. Candidates did score the first mark point but the quality of expression was often poor. The second mark point was rarely seen; many candidates thought that the mtDNA was carried on the X chromosome.

7 Mitochondrial disorders may be caused by mutations in the genes coding for mitochondrial components. Some of these genes are found in mitochondrial DNA (mtDNA) and some are found in nuclear DNA.

Leigh syndrome is an example of a mitochondrial disorder. In this syndrome, a number of different proteins involved in respiration are affected.

These mutations may be inherited or may occur when DNA replicates.

(a) Explain why mutations in nuclear DNA can be inherited from either the mother or the father whereas mutations in mtDNA are only inherited from the mother.

(2)

The During fertilisation, gametes from both parents fuse together with haploid nuclei, meaning the genetic material of an individual egg is half from the mother and half from the father. The mitochondria are only inherited from the ovum, however, as the sperm's mitochondria do not enter the ovum during fertilisation

ResultsPlus
Examiner Comments

This is an example of a response that did score both mark points.

Question 7 (b) (ii)

The candidates who had read the question carefully did write specifically about the effect of the mutation on ATPase. Candidates wrote about ATPase as an enzyme or as a channel, our second and third mark points respectively, but few wrote about both.

(ii) Explain how this mutation could affect oxidative phosphorylation.

(3)

The mutation resulting in guanine instead of thymine will result in a change of amino acid sequence and therefore a change in the shape of the polypeptide chain. This will therefore change the shape of the final enzyme structure, so the shape and chemistry of the active site will have changed. This means that ADP and Pi will no longer fit in the active site so ATP can no longer be synthesised, which makes oxidative phosphorylation pointless.

ResultsPlus
Examiner Comments

This is a very clear response that describes the effect on ATPase in its capacity as an enzyme. 3 marks.

Question 7 (c)

The majority of candidates knew that either a deletion or the formation of a stop codon would shorten the protein. Very few could go on and explain why.

(c) Leigh syndrome can also be due to a mutation in the SURF1 gene.

This mutation results in a shortened protein.

Explain how a mutation can result in a shortened protein being produced.

(2)

- If the codon that has been substituted in is a stop codon.
- this means that the ~~strand would~~ translation of the strand would stop here and the amino acid sequence would be shorter and hence the coded protein would also be shortened.

ResultsPlus
Examiner Comments

This is a clear response that we had hoped to see more of. 2 marks.

(c) Leigh syndrome can also be due to a mutation in the SURF1 gene.

This mutation results in a shortened protein.

Explain how a mutation can result in a shortened protein being produced.

(2)

~~deletions of a gg base in the template means that~~ Mutations can cause base deletions from the sequence, therefore when the DNA is replicated the template is a base short so produces a shortened protein.

ResultsPlus
Examiner Comments

This response is more typical, scoring only the first mark point.

ResultsPlus
Examiner Tip

Read your answer through and ensure that you have made at least as many points as there are marks allocated to the question. Do not count comments that effectively repeat the question.

Question 7 (d)

A range of responses were seen to this question. Quite often vague comments about the electron transport chain not working were seen so our first mark point could not be awarded. The last mark point was rarely seen, although candidates did appreciate that lactate is removed from the muscle by the blood.

(d) Some people with Leigh syndrome have mutations that affect proteins involved in the electron transport chain. cytochro

Explain why these mutations lead to a build-up of lactate. pyruvate → acetyl coA (NAD, NADH+) (NAD, NADH) (3)

- If the cytochromes are affected, then electrons cannot move through electron transport chain
- So $NADH+H^+$ and $FADH_2$ is no longer oxidised by ~~reduced~~ dehydrogenation to form their oxidised forms NAD and FAD
- NAD is required by pyruvate to continue link reaction
- Instead, with absence of NAD, $NADH+H^+$ is being oxidised to NAD by the reduction of pyruvate to lactate.

ResultsPlus
Examiner Comments

Although this response was a bit muddled in the middle, it shows enough understanding to be awarded three marks.

(d) Some people with Leigh syndrome have mutations that affect proteins involved in the electron transport chain.

Explain why these mutations lead to a build-up of lactate.

(3)

If proteins in the electron transport chain (ETC) are affected, then electrons cannot be passed down, proton gradients cannot be created in the inner mitochondrial membrane and reduced NAD cannot be reoxidised. As a result, anaerobic respiration occurs in the cytoplasm of the cell where pyruvate (product of glycolysis) combines with the hydrogen from the reduced NAD to oxidise the NAD. The product is ~~of~~ NAD and lactate. Reduced NAD must be continually reoxidised so it can accept more hydrogens. If the ETC cannot accept these hydrogens, pyruvate must forming lactate and so there is a lactate build up.

ResultsPlus
Examiner Comments

This response is clearer, demonstrating a good understanding of the topic. 3 marks.

Question 8 (b) (i)

The majority of candidates attempted this calculation, although there were a significant number who calculated the minimum width of the gap.

(b) The envelope consists of two membranes. These membranes are separated by a gap of 10×10^{-3} to 20×10^{-3} µm.

The magnification of this electron micrograph is ×12 000.

(i) Calculate the maximum width of this gap in this electron micrograph.

(2)

$A = 20 \times 10^{-3} - 10 \times 10^{-3}$ µm $= 0.01$ µm

A 1 M $\quad M = 12,000$

0.01×12000

~~$I = \frac{0.01 \mu m}{12,000} = 8.33... \times 10^{-7}$ µm~~

$=$

Answer 120 µm

$= 0.12$ mm

1mm = 1000 µm = 1000 000 nm

ResultsPlus
Examiner Comments

This candidate calculated the minimum width thus scoring one mark.

ResultsPlus
Examiner Tip

Always check to see if you are told what units to use. If not, then you must choose sensible units and state them for full marks to be awarded.
Either mm or µm was acceptable. If you are going to give both then make sure that they are both correct.

(b) The envelope consists of two membranes. These membranes are separated by a gap of 10×10^{-3} to 20×10^{-3} µm.

The magnification of this electron micrograph is ×12 000.

(i) Calculate the maximum width of this gap in this electron micrograph.

(2)

$20 \times 10^{-3}\ \mu m = 0.02\ \mu$

$0.02 \times 12000 = 240\ \mu m$

240 µm

Answer 0.24mm

ResultsPlus
Examiner Comments

If the correct answer is given it does not matter if the calculation is not laid out exactly as in the mark scheme.

ResultsPlus
Examiner Tip

Always show your working and state the units.

Question 8 (b) (ii)

Candidates find explaining resolution difficult, and there were many explanations muddled with magnification. Hopefully the mark scheme to this question will act as an exemplar to candidates.

(ii) Explain why the envelope in this electron micrograph cannot be seen as two separate membranes.

(2)

The image seen is from a light microscope, which has a low resolving power. Resolution is a measure of how far apart two objects must be before they can be seen as separate. Since the envelopes are so close together, and the resolving power is low, the two cannot be distinguished

ResultsPlus
Examiner Comments

This was just enough to score two marks. A reference to membranes and not envelope would have been preferred but this candidate clearly understood resolution.

(ii) Explain why the envelope in this electron micrograph cannot be seen as two separate membranes.

(2)

Because the two membranes are very close to each other, and the ~~resolution~~ resolving power of the microscope isn't high enough to seen them as seperate membrane.

ResultsPlus
Examiner Comments

The wording of this is clearer.

ResultsPlus
Examiner Tip

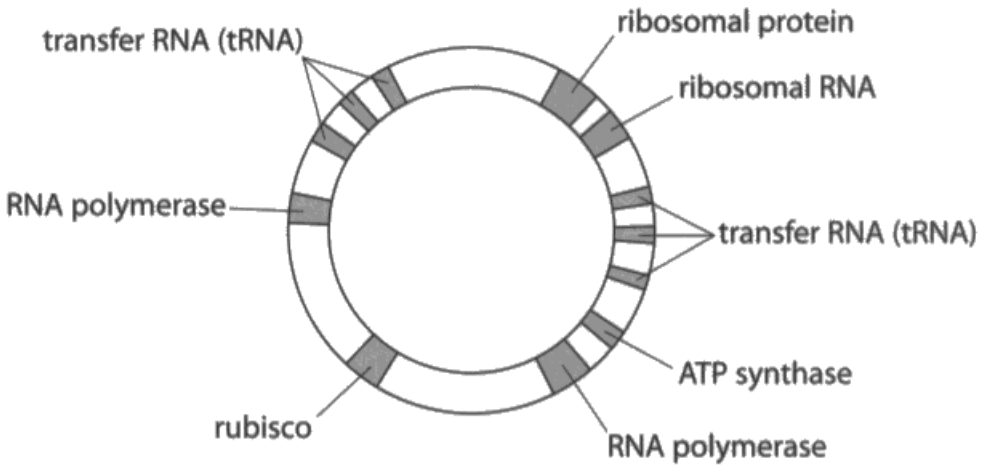
Always use past paper mark schemes to help you prepare for the examination.

Question 8 (c)

Levels-based questions are a new feature in this specification. In general terms, for full marks to be accessed all stimulus material must be commented on and all aspects of the question addressed using A level knowledge. The candidates do not get a mark for each point made. The level descriptors are used to judge the level of the response and the higher or lower mark is awarded depending on what has been written. The indicative content is there as an indication of the sort of comments we would expect to see.

In this question the candidates needed to describe what the graph was showing and link the genes present in the cpDNA to the formation of new chloroplasts and the functioning of the chloroplasts at an A level standard, for level 3. A simple description of the graph / diagram is a level 1 response and some explanation of the data was expected for a level 2 response.

The diagram shows the location of some genes found in cpDNA.



* Analyse the information to explain the changes that occur in a leaf cell as it grows.

(6)

In the graph it can be said that as higher leaf size represents the growing of a leaf cell hence the the larger the leaf cell grows, the more chloroplasts are present in the cell, indicated by a positive correlational line (at 1000 μm = 20 chloroplasts, at 8000 = 200 chloroplasts).

ResultsPlus

Examiner Comments

This candidate has only made one comment about the graph, linking the increase in leaf size with the increase in number of chloroplasts. This is clearly a level one response and was about the minimum required for one mark to be awarded.

As the leaf grows the number of chloroplasts per cell ~~decrea~~ increases as at 1000 μm^2 there are only 24 chloroplast and at 6000 μm^2 there are 145 chloroplasts. At first up to 2000 μm^2 the number of cpDNA per chloroplast increases rapidly from 145 to 200 but then after this it decreases to 20 at 8000 μm^2 with a decrease of 88%. This means that less tRNA and rubisco is available in each chloroplast however as there

ResultsPlus
Examiner Comments

This candidate has made descriptive comments about the graph and the diagram which is a level 1 response. Perhaps if their last sentence had been completed the response may have nudged into level 2.

Generally, as the leaf size grows, the ~~number~~ mean number of chloroplasts per ~~leaf~~ cell also increases. This is due to ~~a greater~~ the growth of ~~chloroplasts~~ cells themselves, allowing a greater surface area for more chloroplasts to fit. In addition, more time means the chloroplasts can divide and produce more of themselves. The cpDNA per chloroplast increases between 1000 μm^2 and 2000 μm^2 (2125 to 200). This is due to the chloroplasts dividing, so ~~they~~ need more cpDNA, so more enzymes such as RNA polymerase can be ~~was~~ produced, so more chloroplasts can be made. This also causes the increase in chloroplast number. After 2000 μm^2 ~~(the)~~ until 4000 μm^2 the number ~~of chloroplasts~~ cpDNA per chloroplast begins to decrease significantly. This is as cell growth has stopped now so enzymes such as rubisco and ATP synthase are no longer needed to produce more glucose for respiration for ATP production. This means less cpDNA is needed to transcribe the enzymes. From 4000 μm^2 to 8000 μm^2, the decrease in cpDNA is gradual (loss of 25). This is as an equilibrium is reached and ~~even~~ there is enough cpDNA per chloroplast, and all the chloroplasts have divided and seperated it's cpDNA.

(Total for Question 8 = 11 marks)

ResultsPlus

Examiner Comments

This candidate has made a really good attempt at explaining the information given so is clearly in level 2. However some of their ideas are not correct so cannot be considered. A mark of 3 was awarded for this reason.

- the amount of chloroplasts per cell increase drastically
- the amount of cpDNA ~~decreases~~ increase up until the leaf reached 2000 μm and then it drops drastically
- the increase in chloroplast per cell is because these are the cells that are needed to create energy therefore the more of the cell has the more energy efficient it is.
- the decrease in cpDNA is because it initially is needed to form more chloroplast but when the number of chloroplast has reached a certain point much less cpDNA is needed and in turn less are present

ResultsPlus
Examiner Comments

This is a clear and concise explanation of the relationship between the data shown in the graph and the cpDNA. A level 2 response that was awarded 4 marks.

As the leaf grows the number of chloroplasts per cell increases. On average for every 1000μm^2 increase in size the number of chloroplasts increases by 25. The mean number of DNA molecules per chloroplast increases ~~for~~ for the first 1000 increase in size upto 200 by but then begins to steeply decrease until 4000μm^2 where it reaches 50. Then it continues to decrease at a slower rate. Due to the higher levels of cpDNA at a smaller size there will be higher levels of RUBISCO, RNA polymerase, and other genes thus more photosynthesis and ~~DNA~~ replication will be taking place.

ResultsPlus
Examiner Comments

There is a degree of interpretation in this response nudging it just into a level 3 response, scoring the lower of the two marks.

At leaf cell ~~egg~~ size 2000, the number of chloroplasts per cell is slowly beginning to increase, and the number of cpDNA molecules per chloroplast is at its peak. The presence of the genes for ribosomal RNA and tRNA suggests these DNA molecules are essential for the production of new proteins which may assist in growth, which may explain why they are so concentrated at the beginning of the graph. However, as the number of chloroplasts increases per cell, the number of cp DNA decreases, as it is less necessary for ~~there~~ there to be large concentrations of cpDNA in one chloroplast, when ~~there~~ there is a higher concentration of chloroplasts overall.

ResultsPlus

Examiner Comments

This candidate is clearly interpreting the data, making it a level 3 response, scoring 6 marks.

Question 9 (b)

Epigenetics is a new topic introduced into this specification. We saw some very good responses, especially describing examples of epigenetic modification. Our third mark point was rarely seen however.

(b) Epigenetic modification is involved in the formation of the antibody-producing cells.

Describe epigenetic modification.

(3)

The genetic control of a cells ~~gene~~ expression. This can be done with ncRNAs or histone modification (histone acetylation or histone methylation) ~~or~~ This can differentiate a cell to produce a specialised cell.

ResultsPlus
Examiner Comments

Although the first sentence is a little clumsy, this response shows the right idea for all three of the mark points to be awarded.

ResultsPlus
Examiner Tip

Use past paper mark schemes to help you express your ideas more clearly.

(b) Epigenetic modification is involved in the formation of the antibody-producing cells.

Describe epigenetic modification.

(3)

epigenetic modification is when genes are switched on or off in a cell e.g by histone arrangment and DNA methylation that bringing about differentiation in a cell but not due to the DNA bas sequence of cell so is not genetically inherited.

ResultsPlus
Examiner Comments

This response is expressed more clearly. 3 marks.

Question 9 (c)

In this question responses showed that candidates had not looked carefully enough at the diagram. Many wrote about the myeloma cells being able to produce antibody and being able to divide.

transcription of a gene

(c) Myeloma cells have the potential to divide indefinitely.

Explain why myeloma cells are used in the production of monoclonal antibodies.

(2)

- so the fused cell that can produce antibodies will also divide by mitosis.
- this mean more monoclonal antibodies can be made in a shorter time, saving time and money and it allows her faster treatment

ResultsPlus
Examiner Comments

This candidate had looked at the diagram carefully and wrote a very clear response. 2 marks.

ResultsPlus
Examiner Tip

Always look at any information you are given very carefully: the question does not include anything that you are not going to need.

(c) Myeloma cells have the potential to divide indefinitely.

Explain why myeloma cells are used in the production of monoclonal antibodies.

(2)

it means they can divide by mitosis to create many monoclonal antibodies to destroy the antigens within the myeloma cells before they are isolated.

ResultsPlus
Examiner Comments

Answers referring to 'they' were very common. Given the stem of the question, 'they' refers to the myeloma cells and not the hybridoma cells. This response scored 0 marks.

ResultsPlus
Examiner Tip

Try to avoid the use of 'it' and 'they'. Name what you are referring to.

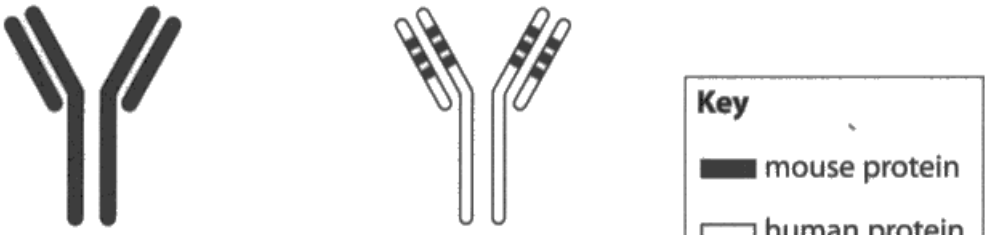
Question 9 (d) (i)

All of the advantages given in the mark scheme were seen; however, few candidates gave three advantages.

(d) The antibodies made by this method are called 'mouse anti-human antibodies'. These antibodies are made by a mouse but are specific to human antigens.

Mouse anti-human antibodies are humanised using recombinant DNA methods.

The diagram shows a mouse anti-human antibody and a humanised antibody.



mouse anti-human antibody humanised antibody

(i) Explain the advantages of using humanised antibodies in the treatment of cancer.

(3)

Humanised antibodies may be able to bind to receptors on the surface of cancer cells & cause agglutination, preventing them from spreading, or opsonisation, labelling them so they are detectable to phagocytes. This will make phagocytosis easier and quicker, allowing the cancer cells to be destroyed by the body. This treatment does not involve invasive surgeries or chemotherapy, which causes illness, so is likely to cause less discomfort/pain to patients.

ResultsPlus
Examiner Comments

This response illustrates the second and fourth mark points.

ResultsPlus
Examiner Tip

If there are three marks allocated to a question such as this, you need to be giving three advantages.

These humanised antibodies are harmless to humans and will not trigger an immune response. They can be easily injected into the blood stream and from there they will locate the cancer cell and can help destroy it. There should be no other negative effects as body cells are not targeted, only cancer cells, whereas current treatments such as radiotherapy and chemotherapy also target healthy body cells and so can cause many harmful side effects.

ResultsPlus
Examiner Comments
A good illustration of the first, third and fourth mark points.

Because the antibodies are less likely to cause an immune response. They are more likely to target the cancer as it is in a human. The antibodies will bind to the cancer cells, clumping them together.

ResultsPlus
Examiner Comments

An illustration of the first and third mark points.

ResultsPlus
Examiner Tip

If you read through this response there are clearly only two advantages given so full marks can never be awarded. Always read through your answer to check that you have made enough points to access full marks.

Question 9 (d) (ii)

This was the second of the levels-based questions. Two such questions will be standard on this paper. It is also the last question on the paper so will be the most challenging.

*(ii) Explain why mouse anti-human antibodies need to be humanised in order to treat cancer. (6)

The mice anntbodies have a different genetic code, ~~therefore~~ therefore the human body will see it as foreign and will try to kill it. Therefore, inserting a human gene, through cancer genes will be the immune system recognise the antibody as its own, thus it will not ~~try~~ try to ~~get rid of it~~, kill it. The non-specific immune system will help the antibodies in fighting the cancerous cells, by producing T-cells. These T-cells divide by mitosis to form a clone army of cells. These later ~~do~~ differentiate into T-killer cells, which release toxins to fight the cancerous cells.

The B-cells are used to memorise the foreign pathogen or cell, so once it invades the body again, it will take less time to fight. Only secondary response will take place.

ResultsPlus

Examiner Comments

This candidate realised that they needed to discuss the immune response in their answer but unfortunately there was a lot of wrong Biology included; no marks were awarded as there is no statement that was correct.

*(ii) Explain why mouse anti-human antibodies need to be humanised in order to treat cancer.
(6)

They need to be humanised because antibodies need to be able to travel through the human blood to reach cancer cells and they need to be well suited for use in the human body. Otherwise, the immune system may attack the antibody and reject it. Therefore it's DNA must be humanised to stop it from being rejected and for it to multiply and create memory cells properly.

ResultsPlus
Examiner Comments

This is a level 1 response. The candidate has written about rejection twice with nothing else added so can only gain one mark.

ResultsPlus
Examiner Tip

When you are reading through your answer, make sure that you have not simply repeated the same thing twice. Your answer may appear to be of a reasonable length but insufficient points may have been made.

*(ii) Explain why mouse anti-human antibodies need to be humanised in order to treat cancer.
(6)

Because mouse anti-human antibodies would still have antigens on the surface which are for mice, not humans so when inserted into the body they would be negonised as 'non-self' and would start an immune response (a unwanted) against them and therefore they wouldn't work. However once humanised the body would recognise them as self and they could start working against cancer cells. Cancer are human cell grows so ~~more~~ antibodies need to be humanised to fight them off.

ResultsPlus
Examiner Comments

Three points have been made but they are all descriptive ones limiting this response to level 1. The higher mark can be awarded as the points are all different.

ResultsPlus
Examiner Tip

You do not get a mark for each correct point made in this type of question. The command word for this question is explain so you will never get higher than a level 1 response if you do not include some reasons in your answer.

*(ii) Explain why mouse anti-human antibodies need to be humanised in order to treat cancer.

(6)

The non humanised antibodies would be recognised as foreign to the host by their own immune system so would trigger specific immune response to try and destroy the antibody and would also cause inflammation and symtoms of a disease as the body gets rid of the antibody. If the antibodies aren't humanised they may not be the correct tertiary /complimentary structure to bind to the antigen on human cancer cells so wouldn't label these cells to trigger phagocytosis of cancer cells. House anti human antibody is only complimentary to mouse antigens on their cell surface membrane

ResultsPlus

Examiner Comments

The first five lines of this response described simple consequences of not humanising the antibodies, putting the response into level 2. The latter half of the response was ignored. Three marks were awarded.

*(ii) Explain why mouse anti-human antibodies need to be humanised in order to treat cancer.
(6)

mouse antibodies will be identified by the patient's immune system as a foreign object, and so will trigger a humoral immune response against it. This will remove all of the antibodies before they can have any effect on the cancer.

They also need to be humanised in order to attach to a human cancerous cell. The variable regions in the humanised antibody have been altered to make them complementary in shape to human cancerous cells.

The constant Fc region also needs to be able to bind to the phagocytic and T-cytotoxic cells in the human immune system, which will enable the cell to be destroyed. Mice antibodies can only cause opsonisation, not they cannot themselves phagocytose cancerous cells.

Most of the variable region is replaced with human protein in order to reverse their specificity to ~~cancerous~~ cells, since mouse anti-human antibodies will bind to any human cell at all, whether it is healthy or cancerous.

ResultsPlus
Examiner Comments

This is an excellent example of a good level 2 response. There is not enough A level immunology to nudge it into level 3.

*(ii) Explain why mouse anti-human antibodies need to be humanised in order to treat cancer.

(6)

-The body will recognise the mouse anti-human antibody as 'non-self' so it will trigger an inimune response.
-The antibody will be ~~digested~~ engulfed by a neutrophil or macrophage in phagocytosis. The phagosome will fuse with a lysosome and digestive enzymes in lysosome will digest the antibodies.
-They therefore wont be able to protect the body. If they are humanised they will be recognised by the body as itself.
-To prevent this the person may have to be given immunosuppresant drugs which so that your immune system doesnt attack the antibodies but this will leave the individual vulnerable to other infection.

ResultsPlus
Examiner Comments

There is a good description of how the antibodies would be destroyed if they were not humanised, pushing this response into level 3. Not enough aspects of the immune response are covered for it to score any more than five marks.

*(ii) Explain why mouse anti-human antibodies need to be humanised in order to treat cancer.

(6)

Humanised antibodies will have specific glycoproteins on their cell membranes which means that they will be identified by the human body as it's own cells. If the mouse bodies antibodies were not humanised the proteins in the membrane would be different to those that our own cells have. This would initiate a humoral response. The antibodies would be then engulfed by a phagocyte. The cancer antibody fragments would continue with on the major histocompatibility complex (MHC) of the cell and be presented on the outside. A t-helper cell would then bind to this and produce cytokines to produce b memory cells and more active b-helper cells. The B-helper cells would then have specific bind to the antibody and become an antigen presenting cell. The cytokines from the b-helper activation stage would stimulate clonal expansion of B-cells to B-plasma cells to more active B helper and B memory cells. The active B cells would differentiate to form B-plasma cells which would produce antibodies specific shape to the antigen on the APC. They would then be killed. So the antibodies would not help and initiate an immune response, instead of treating cancer.

ResultsPlus

Examiner Comments

This candidate not only described how a non-humanised antibody would be engulfed but extended their answer to describe the development of an immune response as a result. A good level 3 response, scoring full marks.

Paper Summary

Teachers and candidates will become familiar with the new specification and style of assessment. The candidates' responses to this paper indicated some specific points that should be addressed in preparing candidates for an examination of this type in the future:

- Candidates need to read each question very carefully and make sure that they use the information in their answers. There are more questions where knowledge has to be applied to new contexts, making this absolutely essential.
- Candidates will need to be taught how to carry out statistics tests and other level 2 mathematical skills. There are 10% of marks for these skills.
- There are usually method marks for calculations worth more than one mark. Candidates should be encouraged to show all their working.
- There are a number of new command words which were not used on this paper but could have been; candidates need to be made aware of these.
- Each question has fewer mark points available than on the previous specification. This means that candidates really have to answer the question and not write down everything they know about a topic. The number of marks allocated to a question should be used to help candidates structure their responses. (For example, Q4(c) was allocated 5 marks meaning that there had to be a total of five similarities and differences given for full marks to be accessed. Another example is Q9(d)(i), where there are 3 marks available so three advantages need to be given.)
- Blank responses score zero. All candidates should be encouraged to attempt each question.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

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