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# Examiners' Report
# June 2022

## GCE Biology B 9BI0 01

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## Introduction

This paper was typical of previous 9BIO1 papers with a range of questions on some frequently tested topics and some less frequently covered spec points. Some of the more frequently tested topics did appear in different contexts in most cases. In the responses to the more frequently covered topics there was evidence that candidates had been prepared for the exam using past paper mark schemes, but unfortunately the information was not always applied to the context of the question.

A range of responses were seen to the two levels-base questions, with some candidates clearly schooled on how to approach this style of question. There were the statutory ten multiple choice questions which saw a range of responses with the first one in question 9 causing candidates the most problem.

The paper also contained the statutory number of maths marks. Candidates appeared to be more prepared for these questions as there were signs of improvements compared to previous series.

## Question 1 (a)(i)

This was intended to be a straightforward start to the paper, where we expected most candidates to name Salmonella as an example of a Gram-negative bacteria.

(i) Name **one** type of Gram negative bacteria that releases endotoxins.

**(1)**

Salmonella

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Examiner Comments

There was the obvious confusion with Staphylococcus. A number of candidates, correctly, named E.coli even though this is not a spec example.

## Question 1 (a)(ii)

Another straightforward question that candidates have been asked before in previous series. The commonest error was to get Gram-negative and Gram-positive bacteria the wrong way round.

(ii) Give **one** difference between the structure of Gram negative bacteria and Gram positive bacteria.

**(1)**

gram positive bacteria has a thick peptidoglycan cal wall which gram negative has a thin one.

**ResultsPlus**
**Examiner Comments**

Most candidates opted for the cell wall difference, as did the candidate who wrote this response

## Question 1 (b)(i)

This was the first of the maths questions. Although the context was different, most of the candidates attempted the question, with many getting it correct.

(b) Endotoxins are usually less toxic than exotoxins.

(i) The $LD_{50}$ value is the mass of the chemical per kg of body mass that would kill half the number of rodent animals.

The $LD_{50}$ value can be used to indicate how toxic a chemical is.

One endotoxin has an $LD_{50}$ value of 11 ng $kg^{-1}$.

The mean body mass of a group of rodents is 28 g.

Calculate the mass of endotoxin given to each rodent that would kill half of the rodents in this group.

28 ÷ 1000 = 0.028 (1)

0.028 × 11 = 0.308 ng kg⁻¹

Answer 0.308 ng

**ResultsPlus Examiner Comments**

This candidate carefully set out their working, making no error. The most frequent error was to multiply 11 by 28, getting an answer of 308.

**ResultsPlus Examiner Tip**

Make sure you can convert a number with one unit into a number with a different unit and always check the units used in the question carefully.

## Question 1 (b)(ii)

A wide range of responses were seen for this question. Weaker candidates thought that the name of the toxin was the name of the bacteria, writing statements such as 'an exotoxin is a Gram-positive bacteria and an endotoxin is a Gram-negative bacteria'. Several candidates did not seem to have any idea what these toxins were and guessed, using the prefix meaning so we got statements such as endotoxins are found in the bacteria and exotoxins are found on the outside.

(ii) State **two** differences, other than toxicity, between endotoxins and exotoxins.

**(2)**

endotoxins are lipopolysaccharides whereas exotoxins are proteins ~~endotoxins~~ exotoxins are released by Gram positive bacteria and endotoxin are not. Exotoxins are released by living bacteria whereas endotoxins are released by dead bacteria breakdown

**ResultsPlus**
**Examiner Comments**

Another mistake was to only give one difference. This candidate has tried to give three differences but did not give enough detail for the first point about the types of bacteria that release the toxins.

**ResultsPlus**
**Examiner Tip**

If you are asked for difference, make sure you give detail about both things that you are describing.

## Question 2 (a)

This should have been straightforward but very few candidates were awarded the crossing over mark point as they did not state that it occurs between the chromatids. Reference to {independent / random} assortment was frequently seen.

**2** A zygote is formed when gametes fuse at fertilisation.

(a) Explain how meiosis results in genetic variation in the gametes.

**(2)**

The random assortment of homologous chromosomes in prophase 1 / metaphase 1 as different bivalents are split up. Recombination / crossing over between non-sister chromatids in prophase 1 This causes different assortments of genes

**ResultsPlus**
**Examiner Comments**

Candidates did not have to state when the events took place, but if they did then it had to be correct. We would have preferred independent assortment to have been described as taking place in metaphase 1, but as prophase runs into metaphase, we did not feel that we could penalise this response.

**ResultsPlus**
**Examiner Tip**

Candidates can struggle with the terms chromosomes and chromatids; it is imperative that you use the correct term in the correct context.

## Question 2 (b)

Candidates tend to know the events that take place during fertilisation quite well. We would have preferred candidates to refer to the secondary oocyte but accepted ovum and egg cell, but we really could not accept egg.

(b) Describe how the process of fertilisation results in the formation of a zygote from the gametes in humans.

**(3)**

A sperm cell swims to the egg cell and the acrosome fuses with the zona pellucida. This triggers the acrosome reaction which releases digestive enzymes such as protease which digest the zona pellucida so the sperm can enter the cell. Once entered, the sperm cell male haploid nucleus fuses with the female nucleus which triggers meiosis II. to occur to complete the full number of chromosomes. This forms a diploid zygote.

**ResultsPlus**
**Examiner Comments**

This is a clear response, illustrating our first three mark points very clearly.

**ResultsPlus**
**Examiner Tip**

Read through your response when you think you have finished it to make sure that you have not made any careless mistakes or used sloppy language.

## Question 3 (b)

Genetic modification questions have been asked in the past, but in different contexts. The basic mark scheme is going to be similar: obtaining the gene, using a vector, detail and cloning the modified organism. Some good responses were seen from candidates that had been prepared for this exam using past papers.

(b) One group of scientists has genetically modified a fungus to produce a spider toxin that kills mosquitoes.

Describe how a fungus could be genetically modified to produce spider toxin.

**(3)**

The gene required for the synthesis of a spider toxin is isolated using restriction endonucleases, a the plasmid is a vector can be used and the same restriction endonuclease is used and the gene is inserted into the plasmid catalysed by DNA Ligase, the recombinant DNA is inserted into the DNA of fungus, the sticky ends of the gene and plasmid join together by complementary base pairing forming Hydrogen bonds.

**ResultsPlus**
**Examiner Comments**

This is a very clear response illustrating the first three points on the mark scheme.

(b) One group of scientists has genetically modified a fungus to produce a spider toxin that kills mosquitoes.

Describe how a fungus could be genetically modified to produce spider toxin.

**(3)**

A gene ~~to~~ that produces the spider toxin can be removed from the spider and then added into a plasmid which acts as a vector. ~~The~~ The vector would then inserted into the fungus and cells will grow to produce spider toxin. ~~These~~ These cells ~~plants~~ can then be ~~cloned~~ cultivated and grown to produce ~~the genetically modified to spider toxin.~~ genetically modified fungi with the spider toxin.

**ResultsPlus**
**Examiner Comments**

This response illustrates our first, third and fourth mark points.

**ResultsPlus**
**Examiner Tip**

Use past paper mark schemes in preparation for exams as they will indicate what you should write in similar questions with different contexts.

## Question 3 (c)

A range of responses was seen to this question, with the commonest issues given as the unethical nature of killing the mosquitoes and the possible negative effect on the food chain. Weaker candidates repeated the stem of the question writing things like 'killing mosquitoes is controversial' or 'tampering with genes is controversial'.

(c) Another group of scientists has discovered a type of fungus that completely protects mosquitoes from infection by the pathogen that causes malaria.

This fungus does not kill the mosquitoes.

Explain why this approach is less controversial than the approach used by the scientists who are developing the genetically-modified fungus.

**(3)**

This approach is likely to be seen as far more ethical as pressure groups do not like the killing of mosquitos ~~xxx~~ as it can reduce biodiversity in a region as it affects the food chain. By killing protecting the mosquito from the pathogen, it prevents the ~~m~~ pathogen from harming humans & so the mosquito does not harm us, and does not need to be killed. This is less controvircil as it does not involve the killing of mosquitos, and does not involve genetic modification which can be seen as unethical.

**(Total for Question 3 = 7 marks)**

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Examiner Comments

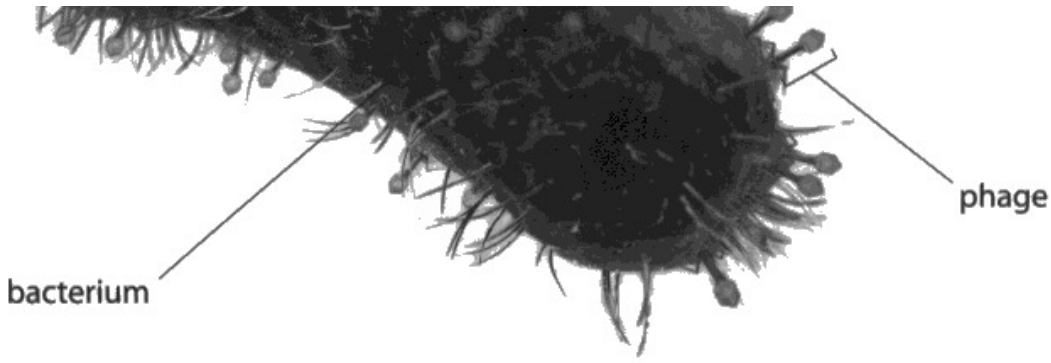
The candidate who wrote this response has given three clear reasons.

ResultsPlus
Examiner Tip

In a question like this, if there are three marks then you are required to give three reasons.

## Question 4 (b)

Magnification calculations that involve changing the units of values are fairly common in these papers. This question involved making two measurements, calculating the magnification using one of them and then using this to calculate the actual size of the other. The mark scheme accepted quite a range of values, provided they were given to the nearest whole number, to allow for the possible measurements that candidates may have made.




(Source: © nobeastsofierce Science/Alamy Stock Photo)

The length of this bacterium is 1.7 µm.

Calculate the length of the labelled phage.

Give your answer in nanometres (nm).

(2)

10cm = 1.7µm
÷1.7 1µm = 5.88cm
÷8.4
0.1 = 0.7cm
mm
×1000
119.047619 nm

Answer 119 nm

**ResultsPlus**
**Examiner Comments**

Selecting a bacteria measurement of 100mm and phage length of 7mm was common. This candidate has thought about the number of decimal places to express their answer to and has realised that a whole number is most appropriate.



**ResultsPlus**
**Examiner Tip**

Making measurements in mm instead of cm will help to avoid an error when converting into other units of length.

## Question 4 (c)(i)

This question was about the lytic cycle, but a common misconception is that all viruses undergo latency. As the time delay was 26 minutes, we really felt it inappropriate to accept mark point 2 in the context of latency.

(i) Explain why there was a delay before the number of lysed cells started to increase.

**(3)**

~~Viruses The virus viral protein sty~~ The virus may have injected their genetic material into host cells which will become replicated and used in viral protein synthesis to assemble new virions. & ~~This The lytic cycle must have occurred at the number of for and it takes The lytic cycle takes time to assemble new~~ There was a delay ~~because cells to be virions A while for virions to~~ lysed because it takes time for virions to be produced in host cells and once assembled, the cell lyses.

**ResultsPlus**
**Examiner Comments**

Candidates are expected to know that lambda phage are DNA viruses and therefore responses had to be specific for the second mark point to be awarded; this is the mark that this response was not awarded.

(i) Explain why there was a delay before the number of lysed cells started to increase.

**(3)**

- viruses are injecting genetic material into host cell.
- first stage of lytic cycle is occurring.
- viruses are replicating RNA/DNA and forming protein capsid using the enzymes and proteins of the host cell.
- virus is assembling viral components inside host cell.

**ResultsPlus**
**Examiner Comments**

This candidate was hedging their bets by naming both types of nucleic acid. We cannot choose which to mark so the second mark could not be awarded.

## Question 4 (c)(ii)

This calculation is actually pretty straightforward but any calculation involving logs confuses many candidates. To allow for this, our first mark point was for simply reading the two values off the graph and dividing by the time difference.

(ii) Calculate the mean rate of increase in the actual number of lysed cells between 50 minutes and 90 minutes.

$\frac{10^{3.8} - 10^{1.7}}{90-50} = 156.486...$
$= 156$ (3sf)

(2)

Answer 156 cells min$^{-1}$

**ResultsPlus Examiner Comments**

This candidate could do the calculation and gave their answer as a whole number.

(ii) Calculate the mean rate of increase in the actual number of lysed cells between 50 minutes and 90 minutes.

1.7
3.8

3.8 − 1.7 = 2.1

40minutes
2.1 in 40mins
$\frac{2.1}{40} = 0.05$

(2)

Answer 0.05 cells min$^{-1}$

**ResultsPlus Examiner Comments**

This was more typical but could be awarded the first mark point as we could see that they had read 3.8 and 1.7 from the graph and divided the difference by 40.

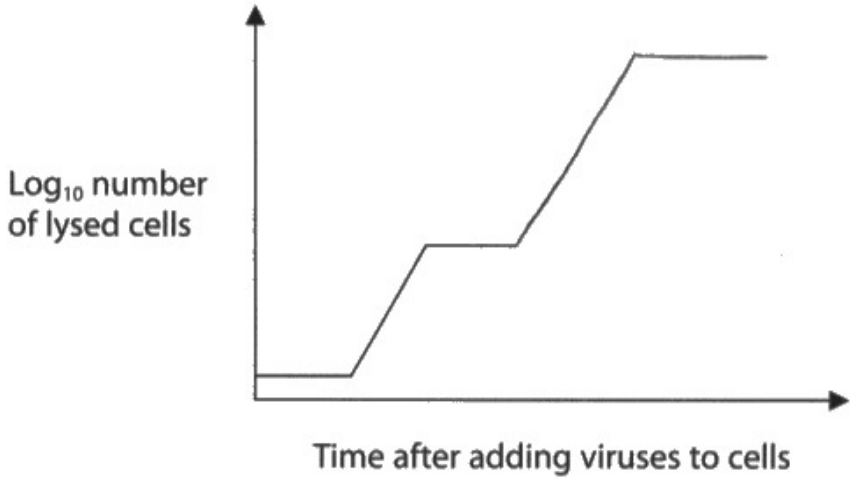
**ResultsPlus Examiner Tip**

Always attempt a calculation as you may pick up method marks even if you get the wrong answer.

## Question 4 (c)(iii)

This question has not been asked before and did require a bit of thought. Many candidates drew a bacterial growth curve, but our more able candidates thought about the question and drew a graph of the correct shape; this question was targeted at these candidates.

(iii) A sketch has been made of this growth curve.




Complete this sketch to predict the shape of the growth curve after 120 minutes, assuming there is an excess of host cells.

**(2)**

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Examiner Comments

This graph illustrates exactly what we were hoping for.

## Question 5 (b)(ii)

Candidates do struggle with describing conclusions that can be made from data. Quite often they describe the individual patterns, not recognising the significant trends or else they do not describe enough conclusions to match the mark allocation for the question. In this question, errors tended to be made in reading values from the graph.

(ii) Analyse the data to identify **three** conclusions that can be made from this graph.

**(3)**

Increasing the level of $CO_2$ increases the rate of photosynthesis

As Temperature increases the rate of photosynthesis increases to a certain level then the rate decreases as enzymes are denatured

Plants grown at a higer $CO_2$ level have a higher optimum temperature than plants not grown in high $CO_2$

**ResultsPlus**
**Examiner Comments**

This is a clear response where the candidate has clearly recognised how many conclusions must be needed. For the optimum temperature conclusion, we did not require values to be given, but if they were they had to be correct. Nor did we allow the values to be simply stated.

**ResultsPlus**
**Examiner Tip**

In a question like this, if there are three marks allocated to a question, then three conclusions will be expected. Always check the question's mark allocation.

## Question 5 (b)(iii)

Candidates are familiar with the light-independent sequence of events, and we saw some accurate accounts of the processes involved. However, not all the accounts were written in the context of the question and did not link the higher carbon dioxide concentration and higher temperatures with an increase in GALP.

(iii) Explain the effects of carbon dioxide concentration and temperature on the rate of formation of GALP.

active site)
Both $CO_2$ and
(4) temperat
are not
limiting
factor

When concentration of $CO_2$ increase. More of the $CO_2$ binds to RuBP to form more GP molecules. More GP molecules are reduced by NADPH and activated by ATP (i.e. ATP undergo hydrolysis to provide energy) to form more GALP. Hence rate of formation of GALP increase. The binding of $CO_2$ and RuBP is catalysed by RUBISCO, an enzyme. As temperature increase, kinetic energy increase, hence more collision happen. More enzyme substrate complexes form. Hence, more GP is formed and more GALP is formed. However, when it passed the optimum temperature, high energy breaks the hydrogen bonds of the protein of the enzymes. Hence shape of active changes, and enzyme substrate complexes could not be formed. Hence binding of RuBP and $CO_2$ is not catalysed, less GP is formed and less GALP is formed.

ResultsPlus
Examiner Comments

This response illustrates all our mark points.




However familiar you are with a particular topic, make sure that you have understood what is being asked of you so that your response actually answers the question.

## Question 6 (a)

This should have been a very straightforward question; a two-mark recall question on an AS topic.

**6** The lipid content of the cell membranes of prokaryotic organisms changes in response to changes in the environmental temperature.

(a) Phospholipids form a bilayer in the cell membranes of bacteria.

Describe the structure of a phospholipid.

**(2)**

Phospholipids have a phosphate group which is bonded to a glycerol molecule. The glycerol molecule is also bonded to two fatty acid chains.

**ResultsPlus**
**Examiner Comments**

This is an example of the type of responses we had expected.

6 The lipid content of the cell membranes of prokaryotic organisms changes in response to changes in the environmental temperature.

(a) Phospholipids form a bilayer in the cell membranes of bacteria.

Describe the structure of a phospholipid.

**(2)**

A phospholipid is a phosphate and fatty ~~acid~~ lipid group joined together. ~~with~~ They consist of a phosphate head, which is hydrophyllic, and a fatty acid (lipid) tail, which is hydrophobic.

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Examiner Comments

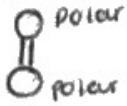
However, this response is much more typical of the response that we did get, with no mention of the glycerol component.

## Question 6 (b)

This question was asking candidates to combine their knowledge of water and phospholipids and apply this to a novel molecule. Very few candidates appeared to have read the question carefully enough as there were numerous accounts describing the structure of a phospholipid bilayer.

(b) The cell membranes of most organisms belonging to the domain Archaea are lipid monolayers.

The lipid that forms this monolayer is a bipolar lipid.




Explain why a bipolar lipid is a suitable molecule to form the cell membrane.

**(2)**

Bipolar lipids have two hydrophilic ~~head~~ parts. The two hydrophilic parts shield the ~~fatty~~ hydrophobic fatty acids from water. The polar parts of the molecule face outwards and interact with water while the ~~fat~~ non polar fatty acids are shielded inside the monolayer.

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**Examiner Comments**

This response was one of the better ones that we saw, with the sketch at the top clearly indicating that this candidate had read the question carefully and knew what was being asked.

(b) The cell membranes of most organisms belonging to the domain Archaea are lipid monolayers.

The lipid that forms this monolayer is a bipolar lipid.

Explain why a bipolar lipid is a suitable molecule to form the cell membrane.

(2)

This allows for the hydrophilic parts (phosphate heads) to be facing the aqueous environment while hydrophobic fatty acid tails to be facing against eachother, preventing charged molecules to pass through the structure.

**ResultsPlus**
**Examiner Comments**

This was more typical of the responses that we saw.

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**Examiner Tip**

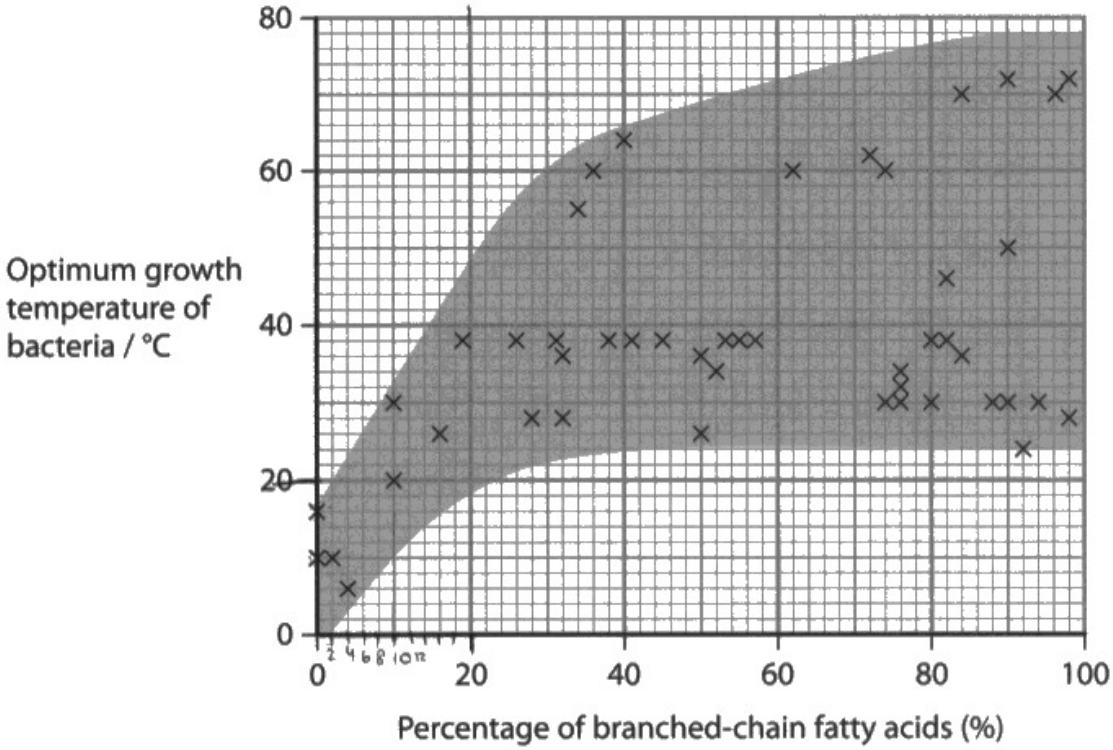
Read the question through a couple of times to make sure you know what is being asked instead of assuming what is being asked.

## Question 6 (c)(i)

This one mark maths question was testing the candidates on their ability to interpret data from a graph and their understanding of inequalities.

(c) The percentage of branched-chain fatty acids in membranes of bacteria that have different optimum growth temperatures was investigated.

The graph shows the results of this investigation.




(i) Calculate the mean percentage of branched-chain fatty acids in bacteria whose optimum growth temperature is <20 °C.

(1)

$\frac{0+0+2+4}{4} = \frac{6}{4} = \frac{3}{2} = 1.5$

Answer 1·5 %

**ResultsPlus Examiner Comments**

A range of responses were seen; this candidate clearly knew exactly what to do.

## Question 6 (c)(ii)

This question was targeted at the more able candidates. Although there is one obvious conclusion that can be drawn from this data, finding a second conclusion is much more challenging.

(ii) Analyse the data to describe **two** conclusions that can be drawn from this investigation.

(2)

As the percentage of branched-chain fatty acids increases, the optimum growth temperature of bacteria also increases.

It has a positive correlation

As the % branched-chain fatty acids increases, the optimum growth temperature range increases

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Examiner Comments

This is an example of one of the better responses that we saw.

## Question 6 (d)

The stem of this question mentions both permeability and fluidity so we were hoping that candidates would pick up on this and write about the importance of permeability and fluidity in the functioning of the cell membrane.

(d) A change in temperature can affect the permeability and fluidity of the membrane.

Explain why it is important that the lipid composition of the membrane of prokaryotic organisms changes if the temperature changes.

**(3)**

When there is an increase in temperature, the membrane becomes more fluid and permeable. This allows for a faster rate of diffusion to occur. This is important as an increase in temperature increases the kinetic energy therefore enzyme reactions can happen faster. Since prokaryotic organisms rely on diffusion, an increase in permeability means more nutrients can diffuse in therefore more enzyme-substrate complexes can form therefore more growth can occur.

**ResultsPlus**
**Examiner Comments**

Many candidates such as this one, linked the fluidity to making the membrane more permeable but did not link the fluidity to the membrane being able to change its shape.

## Question 7 (a)(iii)

Many candidates recognised that this question was testing them on osmosis, and we saw some good explanations for the movement of water into the macrophage. Less able candidates got the direction of flow the wrong way round if they were trying to use the term water potential or else they wrote about the water concentration, limiting themselves to the osmosis mark.

(iii) Explain why water flows into the part of the cell where the soluble components are located (**Step 3**).

**(2)**

Water flows into this part of the cell due to a lower water potential within this region of the cell. So, due to osmosis, water moves from a region of higher water potential ~~(concentration)~~ to a region of lower water potential. This is because more solutes than solvent is in step 3, and the ~~solution~~ movement of water is due to hypotonic behaviour.

**ResultsPlus**
**Examiner Comments**

This candidate clearly understands this part of the specification.

**ResultsPlus**
**Examiner Tip**

Avoid referring to water concentration. If you are unsure about using the terms water potential and osmotic potential, then express your answer in terms of the solute concentration.

## Question 7 (a)(iv)

Candidates clearly understand the role of macrophages as antigen presenting cells to T helper cells. Marks tended to be lost in this question because candidates did not name the CD4 antigen on the T helper cell to which the MHC-antigen complex binds.

(iv) Describe the events that take place resulting in T helper cell activation, following the formation of pseudopodia by the macrophages (**Step 4**).

**(3)**

after pseudopodia form around bacteria, the bacterias antigen are presented on the macrophage, on the MHC presenting site, this is then attatches to the CD4 receptor site on the T-helper cell to activate T-hapor cells.

so it becoming an antigen presenting cell

**ResultsPlus**
**Examiner Comments**

This response illustrates all our mark points except the first one.

(iv) Describe the events that take place resulting in T helper cell activation, following the formation of pseudopodia by the macrophages (**Step 4**).

**(3)**

- the macrophage will engulf the bacteria forming phagosome around it
- Lysosome attaches to phagosome and releases lysozymes into phagosome cause breaking down of bacteria
- Antigen of bacteria is presented on surface using MHC protein
- T helper cell with complementary ~~antibody~~ antigen receptor/antibody to the antigen will bind to antigen presenting macrophage
- It will then become activated

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**Examiner Comments**

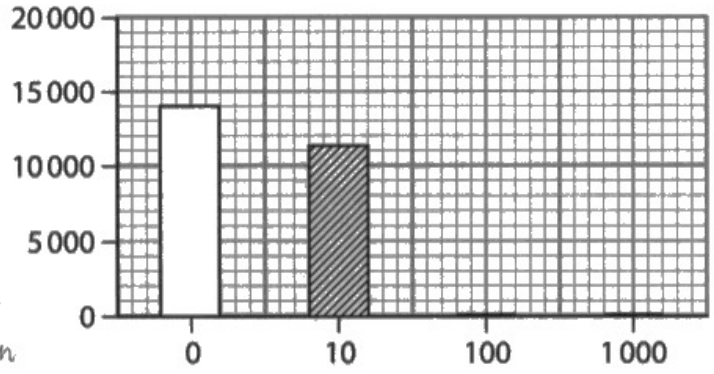
This candidate did not name the T helper cell receptor molecule but still scored full marks as they described what happens before antigen presentation.

**ResultsPlus**
**Examiner Tip**

Make sure you know the difference between a lysosome and lysozyme and check your answer through to make sure that you have not used the wrong term by mistake under the pressure of the exam.

## Question 7 (b)

This was the first of our two levels-based questions. We saw some well-structured responses, suggesting that centres had prepared their candidates for these levels-based questions. The more able candidates discussed the four graphs in the order that we had presented them, easily achieving a level two mark and often pushing themselves into a level three by focussing on the extra information that graph three showed. Less able candidates either did not write about all the graphs or else wrote everything they knew about macrophages and phagocytosis.




ATP needed for endocytosis (phagocytosis)

more inhibitor : less green : less phagocytosis : less mo engulfed.

* The concentration of microorganism has a greater effect than number of macrophages as the green glow is higher.

Analyse the data to discuss the factors that affect phagocytosis by macrophages.

**(6)**

As the number of macrophages increase, the extent of the green glow also increases because there are more microorganism being engulfed by phagocytosis due to the ^increased number of macrophages available.* As the concentration of micro-organisms increase, the extent of green glow also increases as there are more microorganisms to be engulfed.☆ Bacteria A is engulfed more than bacteria B in the lungs (by 6 times) and in the abdomen (by 2.4 times) but is engulfed less in the bone barrow where bacteria b is engulfed more (by 1.4 times). Therefore type of bacteria and location affect phagocytosis by macrophages, however this is only 2 types of bacteria and 3 locations so with a larger sample size, the result may be different†. As ATP synthase inhibitor concentration increases, extent of green glow decreases and passed 100 a.u. the extent of green glow is almost 0. This is because phagocytosis is an active process meaning it requires ATP which is formed by $H^+$ ions pump through ATP synthase enzymes in the mitochondrial membrane in aerobic respiration. So with less more inhibitor, less ATP is made so less phagocytosis can occur.

* The macrophages have to travel a less distance by chemotaxis to the microorganism as there are more of them.

**(Total for Question 7 = 13 marks)**

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Examiner Comments

This is an example of a level three response. All four graphs have been discussed with more than just one comment on some of the graphs.

ResultsPlus
Examiner Tip

The trick with these levels-based questions is to write a little about a lot and not a lot about a little. If there are four graphs shown in the question then you must write about all four to access the higher marks; if you only write about a couple of them, then you have not answered the question in full so will not score highly however well you have written your response.

## Question 8 (a)(i)

Historically, candidates have found expressing values in ratios quite challenging, but in this series there appeared to be more candidates able to do this.

**8** Hypoxia is an inadequate supply of oxygen to tissues and cells that restricts their function.

(a) The normal partial pressures of oxygen vary from tissue to tissue.

The table shows the normal partial pressure of oxygen in two tissues.

| Tissue | Partial pressure of oxygen / kPa |
|---|---|
| Pulmonary arterial blood | 5.3 |
| Other arterial blood | 13.3 |

(i) Calculate the ratio of the partial pressures of oxygen in these two tissues. Give your answer to one decimal place.

**(1)**

5·3 : 13·3

1 : 2·5

Answer 1 : 2·5

**ResultsPlus**
**Examiner Comments**

As we had not specified which way round to express the ratio, we accepted both ways round.

**ResultsPlus**
**Examiner Tip**

One value must always be a '1' when writing values as a ratio.

## Question 8 (a)(ii)

This question was very straightforward and barely above GCSE level, provided candidates knew that the partial pressure of oxygen related to how much oxygen was being carried in the blood. Marks were lost by candidates who did not link the low partial pressure with deoxygenated blood and the high partial pressure with oxygenated blood, by candidates who confused partial pressure with blood pressure and by candidates who confused the pulmonary artery with the pulmonary vein.

(ii) Explain why the partial pressures of oxygen in these two tissues are different.

**(2)**

The pulmonary artery carries deoxygenated blood towards the lungs, and therefore would have lower amounts and partial pressures of oxygen. other arteries would ~~[illegible]~~ be carrying oxygenated blood around the body, and would therefore have higher amounts of oxygen.

**ResultsPlus**
**Examiner Comments**

This candidate made none of the errors listed.

## Question 8 (b)(i)

We recognise that epigenetics is a new topic to the spec and that candidates found the topic difficult. Candidates did very poorly on this question, but those that did picked up on this and did not panic and found the question straightforward. Unfortunately these candidates were few and far between and there were a lot of blank responses.

(b) The body responds to hypoxia by releasing hypoxia-inducible transcription factors (HIF).

Investigations have shown that one effect of HIF is an increase in the rate of glycolysis in the affected cells.

(i) Explain how HIF could result in an increase in the rate of glycolysis.

**(2)**

HIF could bind to DNA and act as a transcription factor - switching genes on that code for enzymes involved in glycosis. More enzymes will increase the rate at which enzyme controlled reations occur.

**ResultsPlus**
**Examiner Comments**

This candidate had read the question carefully and demonstrated that they knew the role of transcription factors.

## Question 8 (b)(ii)

Responses to this question were quite disappointing as it was only testing the role of oxygen in oxidative phosphorylation. Surprisingly, many candidates wrote that glycolysis needed to be faster to generate more oxygen for aerobic respiration; this is not a misconception that we have picked up on in the past.

(ii) Explain why cells need to respond to hypoxia with an increase in the rate of glycolysis.

(4)

• Hypoxia means less oxygen is available to cells so act as the terminal electron acceptor in the electron transport chain (ETC), so hence oxidative ~~phosphorylation~~ phosphorylation cannot occur as electrons cannot be passed down membrane proteins to release energy to create a concentration gradient of $H^+$ ions for them diffuse through ATP synthase to make ATP for energy. Hence, ~~energy~~, ATP must by ~~released~~ produced by anaerobic respiration as the accumulated NADH is oxidised by pyruvate formed in ~~glucose~~ glycolysis so NAD can accept more hydrogen. Repeated glycolysis hence releases ~~some~~ small amounts of ~~all~~ energy as ATP for the cell to carry out active transport and other metabolic processes in order to live.

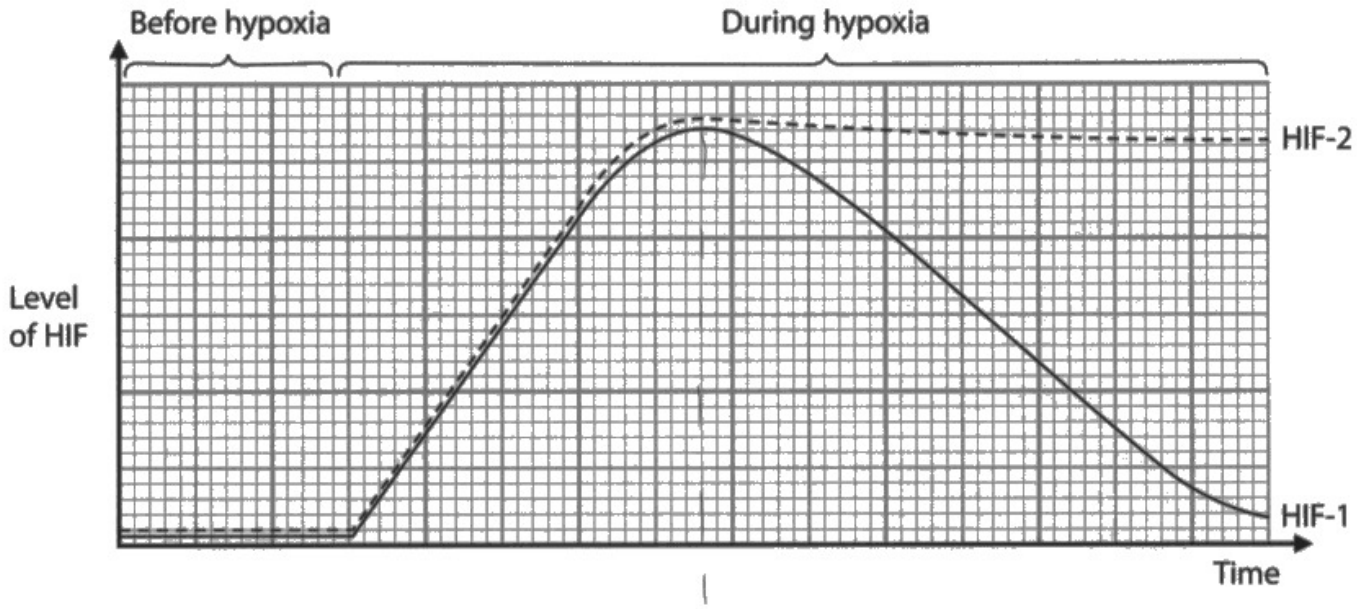
ResultsPlus
Examiner Comments

Not all candidates took this approach, and we did see some very good answers, as illustrated by this response.

## Question 8 (b)(iii)

The command word 'compare and contrast' was new to this spec and in the early papers caused candidates problems. It now appears that centres are preparing their candidates for this command word as we saw a lot of responses where the candidates were scoring both marks.

(iii) The graph shows the changes in levels of two HIFs, HIF-1 and HIF-2, before and during hypoxia.




Compare and contrast the changes in the levels of HIF-1 and HIF-2 during hypoxia.

**(2)**

Initally they are both the same before hypoxia. During hypoxia they both start increasing at the same rate but after HIF-1 reaches a peak and then levels start decreasing. At the same time HIF-1 ~~decreases~~ starts decreasing, HIF-2 remains the same

ResultsPlus
Examiner Comments

This is one such example.



**ResultsPlus**
**Examiner Tip**

Compare and contrast means that you must give both similarities and differences between two things, in this case the data. Each similarity or each difference must be written in the same sentence, or at least linked together as in this response. You cannot be awarded marks for two separate descriptions.

## Question 8 (b)(iv)

This question was targeted at the more able students but still performed badly. Many candidates thought that the HIFs were molecules involved in glycolysis, completely missing the fact that we had told them that they were transcription factors. Candidates who did realise that they were transcription factors did not refer to the gene products role in glycolysis. Several candidates left the response blank.

(iv) Explain the changes in levels of HIF-1 and HIF-2 during hypoxia.

**(2)**

HIF-1 decreased because glycolysis could take place without the gene being transcribed further.

HIF-2 was needed to produce a protein to increase a gene/protein required in glycolysis.

**(Total for Question 8 = 13 marks)**

**ResultsPlus**
**Examiner Comments**

This was one of the better responses, but full marks were still not obtained.

## Question 9 (b)(i)

Responses to this question were a little surprising as we had thought it to be a straightforward question. Many candidates wanted to collect the water lost from the insect and weigh that. Those who realised you had to weigh the creatures did not go on to say that a subtraction calculation needed to be done.

(b) Spiracles are small openings in the exoskeletons of insects that allow air to enter the respiratory system.

Water can evaporate out of the spiracles when they are open. The insect can close the spiracles to reduce water loss.

In an investigation, the water loss from insects in air with different humidities was measured.

The insects were kept in air with 80% humidity and then moved into air with a lower humidity. Water loss was then measured.

The investigation was repeated in air high in carbon dioxide to keep the spiracles open.

The table shows the results of this investigation.

| Percentage humidity (%) | Water loss from insects / mg $hr^{-1}$ | |
|---|---|---|
| | Insects in air | Insects in air high in carbon dioxide |
| 0 | 0.10 | 0.90 |
| 20 | 0.13 | 0.68 |
| 40 | 0.15 | 0.50 |
| 60 | 0.13 | 0.35 |
| 80 | 0.07 | 0.07 |

(i) State how the water loss could have been measured in this investigation.

**(1)**

-weigh insect before and after and calculate difference

**ResultsPlus**
**Examiner Comments**

This question did not cause this candidate a problem.

## Question 9 (b)(ii)

Percentage calculations always cause problems to several candidates and this one was no exception. We saw a wide range of different answers.

(ii) Calculate the percentage increase in water loss from the insects kept in air at 0% humidity compared with those kept at 80% humidity.

Give your answer to two decimal places.

(1)

$$\frac{0.1 - 0.07}{0.07} \times 100 = 42.86$$

Answer 42.86 %

**ResultsPlus Examiner Comments**

This candidate clearly knew what they were doing.

**ResultsPlus Examiner Tip**

Look through the maths skills requirement in the appendices and make sure you can do calculations such as percentages as they do crop up on the papers quite frequently.

## Question 9 (b)(iii)

A reasonably high proportion of candidates wrote about the humidity needing to be the same as it was a control variable, missing the significance of the 80% humidity. Those who focussed on the 80% picked up marks, usually the second one.

(iii) Explain why the insects were kept in air with 80% humidity at the start of this investigation.

**(2)**

So they all started with the same amount of water loss occurring their spiracles were all either open/closed

to ensure they all had the same volume of water to start with → excess water → not dehydrated

**ResultsPlus**
**Examiner Comments**

This candidate started on the controlled variable idea but eventually mentioned the idea of preventing dehydration.

(iii) Explain why the insects were kept in air with 80% humidity at the start of this investigation.

**(2)**

• There would be less water loss from the insects body

↳ then change would be more apparent

**ResultsPlus**
**Examiner Comments**

This response nearly scored two marks; the candidate just needed to state that the change would have been apparent at the lower humidities to have scored the first mark as well as the second.

**ResultsPlus**
**Examiner Tip**

If a specific value has been included in the question, then you need to focus your answer on why that value and not another.

## Question 9 (b)(iv)

There were some good attempts at explaining this data and candidates have a clear understanding of the role of the spiracles. Marks were limited by the number of points that candidates made.

(iv) Explain the results of this investigation.

(3)

insects in air high in $CO_2$ & had more ↓ spiracles open as they are trying to maximise $O_2$ intake, this resulted in them losing more water, as compared with insects in air who would have had less spiracles open. Generally, as humidity increased water loss decreased, this is because less ↓ water would not evaporate out dm to osmosis as water levels outside insect were higher.

**ResultsPlus**
**Examiner Comments**

This is a clear explanation that did not go quite far enough to score full marks.

**ResultsPlus**
**Examiner Tip**

Look at the data in a question like this and work out how many different aspects are being covered. In this case there were two independent variables: humidity differences and the presence / absence of carbon dioxide. Next look at the number of marks allocated to a question to guide you into how many points you need to make.

## Question 9 (c)(i)

This calculation was targeted at the more able candidates as the question had to be read carefully, the data interpreted carefully and then the answer given in standard form, which candidates can find difficult.

(i) Lamellae are present on both sides of the gill filaments.

The mean length of a gill filament is 25 mm.

Calculate the total number of lamellae on the gill filaments of *Thunnus*.

Express your answer in standard form.

**(1)**

$24 \times 25 \times 2 \times 6480 = 7.78 \times 10^6$

Answer $7.78 \times 10^6$

**ResultsPlus**
**Examiner Comments**

This candidate clearly knew what was expected of them.

**ResultsPlus**
**Examiner Tip**

If you are expressing an answer in standard form, then you must have one value only to the left of the decimal point.

## Question 9 (c)(ii)

This was the second of our levels-based questions and despite being the very last question on the paper we saw some very good attempts at answering this question. Many candidates clearly understand the role of the gills in fish gas exchange and gave clear explanations.

*(ii) Analyse the data to explain the relationships between the activity of these fish and the structure of their gills.

$\frac{1665}{26} \div \frac{478}{39} = 3.22$ active fish more gill filaments than inactive fish

↖ from active fish has larger total no. of gill filaments per gram compared to inactive fish

(6)

- Active species tend to have a larger total number of gill filaments compared to inactive species and have a larger SA of gills /$cm^2$ $g^{-1}$ of fish than inactive species
- This can be explained because more active fish require more oxygen than inactive fish since they are using more muscle groups → increasing number of gill filaments increases the surface area for diffusion to take place, which explains why the SA of ~~inact~~ active fish > inactive fish.
- Higher lamellae number on active fish also increases surface area for ~~diffusion~~ flow of water to saturate & steeper conc. gradient so more oxygenated blood filaments → helps to maintain counter-current flow
- Diffusion distance between water and blood is also shorter for active fish as this enables a steep concentration gradient to be maintained and allows for blood to be in contact with oxygen for longer

ResultsPlus
Examiner Comments

This is one example of a level three response with an explanation that talks about muscle contraction, which is important as the data is comparing groups of fish with different levels of activity.

*(ii) Analyse the data to explain the relationships between the activity of these fish and the structure of their gills.

**(6)**

The more active the fish the higher the surface area of the gills per gram this is because more active fish require more gas exchange to proride cells with more oxygen for respiration to make more ATP to power muscles. The more active fish also have more gill filaments on average as these provide more SA for gas exchange Also as they are moving faster the filaments will spread out more resulting in ~~the~~ more space ~~ability~~ for water inbetween so it makes sense to have more filaments they also tend to have more lamellae per filament to further increase the surface available for gas exchange. On average active fish also have ~~pro~~ longer distances between water & blood to reduce the diffusion pathway as muchas possible as this also increase rate of gas exchange. Tinca seem to be an anomaly with high nombers of filaments & gills suggesting they are moderatly active

**(Total for Question 9 = 16 marks)**

ResultsPlus
Examiner Comments

This is an example of another level three response.



**ResultsPlus**
**Examiner Tip**

In this question there is only one table of data. To structure your answer, you need to look at how many structural aspects about gills are included in the table, four, and write an explanation that covers all four of these features.

## Paper Summary

Overall the paper worked as intended, with the exception of 8(b) and some very good clear responses were seen. Centres are clearly using past paper mark schemes to prepare their candidates and are taking on the comments that we make in our post-exam reports. The following points have been made in previous reports but still apply.

Based on the performance of this paper, candidates should follow this advice:

- Candidates need to read the question carefully to identify the command word and the various aspects that they need to cover in their answer. One of the appendices in the spec lists the command words and what is expected; this should be shared with candidates
- The mathematics appendix should also be shared with candidates and the skills taught to candidates as part of their preparation for the exam
- Careful consideration of the number of decimal places or significant figures to express an answer in is necessary if the question does not specify. If the question does specify then the instruction must be followed for full marks to be accessed
- Workings to calculations should be shown
- The marks allocated to a question should be used to judge how much to write
- Levels-based responses should cover all aspects of the question and not focus on one small component
- Diagrams should be drawn accurately to represent exactly what is being drawn
- All questions should be attempted and leaving blanks avoided.

## Grade boundaries

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

https://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html

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