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# Examiners' Report
# June 2019

## GCE Biology 9BI0 01

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# Introduction

This was the third paper of the new specification and it was evident that centres are covering the content of the specification better and preparing their candidates for the levels-based questions. There were fewer blank responses towards the end of the paper, suggesting that centres are increasing the awareness of candidates to the length of the new-style papers.

All the mark points were seen but not necessarily in one response. Candidates are not recognising the number of marks allocated to a question or putting sufficient A level detail into their answers. The multiple choice questions saw a range of responses and were quite discriminating.

## Question 1 (b) (i)

The majority of candidates knew that DNA fragments were charged and moved through the gel according to their mass or length. However there was a lot of confusion over what the charge was, the direction of movement and which property caused the fragments to move the furthest. A common misconception was that the longer the fragment, the greater the charge.

(i) Explain why fragments of DNA can be separated by gel electrophoresis.

**(2)**

Fragments of DNA have a negative charge. A current is applied to the gel and the fragments are attracted. They are separated due to the size. ~~Smaller~~ smaller particles move towards the electric field faster than the ~~them~~ heavier ones.

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**Examiner Comments**

This is one example of a response that was awarded full marks.

## Question 1 (b) (ii)

This question was not a problem for those candidates who realised that it would be inappropriate to give their answer to one or more decimal places.

## *Question 2 (b)*

Part (i) caused candidates a lot of problems and the only marks awarded tended to be for 1.9 or 1.92 which we decided to accept for 1 mark.

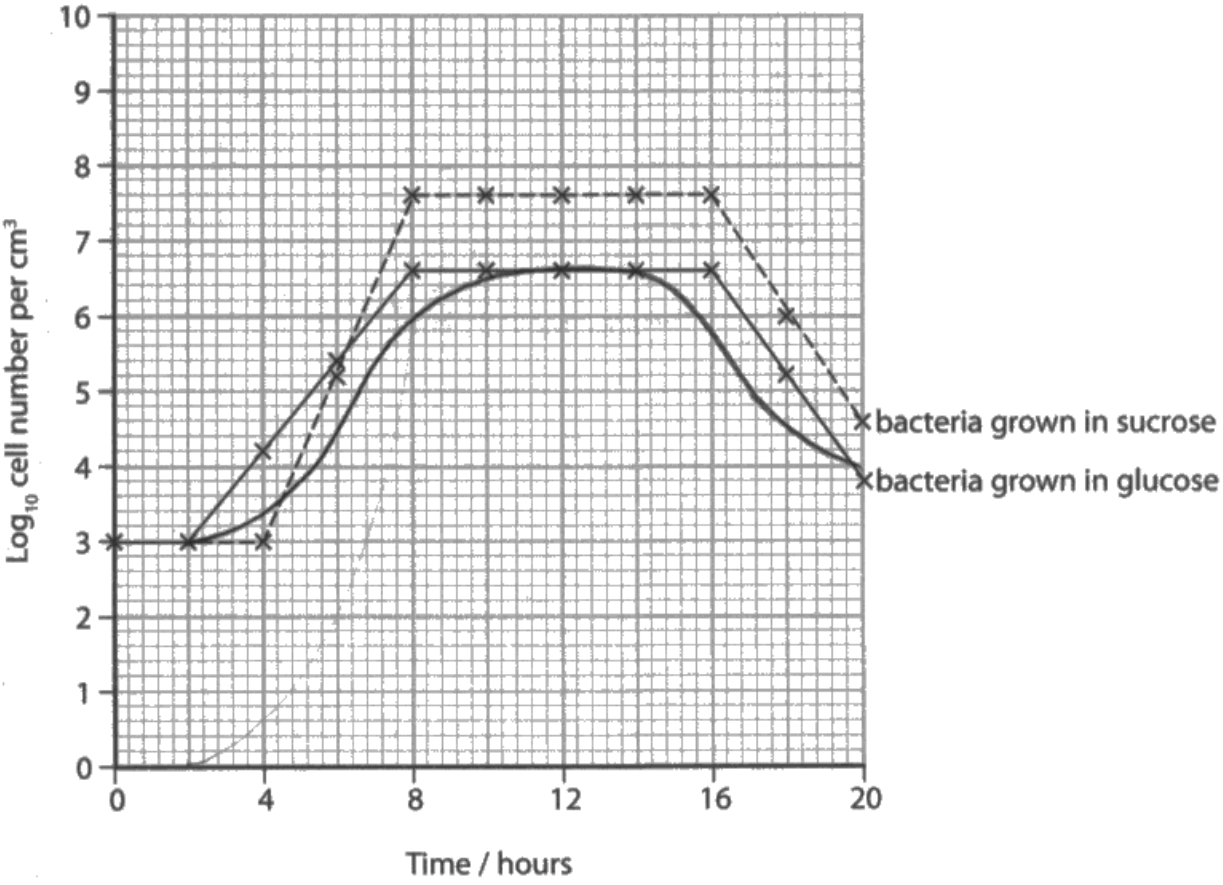
We saw both mark points in the responses to part (ii) but rarely both together in one response. A common mistake was to state that sucrose was made of two glucose molecules.

Part (iii) was poorly done; it is evident that candidates do not really understand the differences between what is being measured by optical density and dilution plating methods.

(b) Bacteria were grown in each medium for 20 hours.

Every two hours, the numbers of bacteria were determined using dilution plating and an optical method (turbidity).

The graph shows the results from the dilution plating.



(i) Calculate how many times faster the bacteria in sucrose reproduce than the bacteria in glucose, during the log phase.

(2)

glucose: $\frac{6.6-3}{8-2} = 0.6$

Sucrose: $\frac{7.6-3}{8-4} = 1.15$

$\frac{1.15}{0.6} = 1.916667$

Answer 1.92

(ii) Analyse the data to explain why the growth curve for sucrose is different from the growth curve for glucose.

(2)

The lag phase is longer for sucrose because it takes a longer time for hydrolysis of sucrose into ~~glucose~~ its monosaccharides fructose and glucose, to be used as an energy source whereas in glucose medium, it is already a monosaccharide for use in respiration. The sucrose has a greater rate of increase in bacteria number because after hydrolysis there is double the number of monosaccharides for use in respiration to produce energy. So more divisions can occur.

(iii) On the graph, draw a curve to show the number of bacteria grown in glucose as determined by the optical method.

(1)

★

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**Examiner Comments**

Part (i) is an example of a calculation that we saw that gained 1 mark by the candidates who appreciated that their answer should not be expressed to more than two decimal places.

Part (ii) is a good example of the type of response that we were looking for to award 2 marks.

The graph in part (iii) shows just one of a large variety of lines that we saw.



**ResultsPlus**
**Examiner Tip**

Always check that you are giving your answer to an appropriate number of decimal places.

## *Question 3 (b)*

The knowledge that candidates have about stem rust fungus is variable. Many candidates wrote everything that they knew about the infection of plants with the fungus and did not focus on the effect once the plant is infected. Mark point 4 was common but very few candidates actually stated that the vascular tissue was damaged so we did not award mark point 3 very frequently.

(b) Explain how stem rust fungus results in a reduction in grain yield.

**(3)**

The fungus prevents transcription as it breaks the epidermis of the plants. It prevents growth by using the nutrients that the plants require for growth. It weakens the stems so they go floppy and so cannot be harvested. The fungus pustules contain spores that can spread to other plants nearby and infect them too, reducing grain yield.

**ResultsPlus**
**Examiner Comments**

This is a typical response that was awarded mark points 1 and 4.

**ResultsPlus**
**Examiner Tip**

Always check that your answer is extended sufficiently to actually answer the question. Yes, the fungus absorbing the nutrients will affect the yield but specifically, why? You need to add in some A level knowledge.

## *Question 3 (c)*

Responses to this question were variable, depending on the extent to which candidates read the question and used the diagram provided. Those candidates who wrote about the formation of the basidiospores generally scored mark point 1 and then extended their answer to get mark point 2. Many candidates knew that a mutation (mark point 3) may also be involved but many thought that crossing over actually caused the mutation and were therefore not awarded this mark. Only the really good responses scored the fourth mark point.

(c) Cereal crops have been genetically modified (GM) to produce plants that are resistant to stem rust fungus.

Analyse the diagram to deduce why the formation of basidiospores and urediniospores can produce a stem rust fungus to which these GM plants are no longer resistant.

**(3)**

urediniospores reproduce asexually so can be produced in large quantities and quickly so when they infect crops and the crops release teliospores these divide by meiosis so the ~~eetts~~ basidiospores are not genetically identical due to crossing over /independent assortment so they can infect a different host, even a GM host as new combination of alleles that GM plant may not be resistant too. when they reproduce asexually they may mutate too.

**ResultsPlus**
**Examiner Comments**

This response illustrates the first three mark points.

**ResultsPlus**
**Examiner Tip**

Always read the question very carefully and use the information in the diagram if you are told to do so. A diagram is only included if you need to use it.

## *Question 4 (a) (ii)*

The responses to this question showed clearly that the majority of candidates do not appreciate the difference between resolution and magnification. There are also a significant proportion of candidates who do not fully understand that mitochondria is not a cell.

(ii) **Explain the difference in appearance of the parts labelled C using the two different electron microscopes.**

**(2)**

- In photograph P the electron microscope has lower resolution so C only appears to be one membrane
- In Q, the resolution must be higher because the two membranes can now be seen as separate

**ResultsPlus**
**Examiner Comments**

A really nice illustration of two mark points.

**ResultsPlus**
**Examiner Tip**

Magnification and resolution have different meanings so you must be careful to select the appropriate term and not write down both in the hope that one will be accepted. Your examiner will not choose which part of your answer to mark.

## *Question 4 (b)*

A range of responses were seen to this, the first of the two levels-based questions. A large proportion of candidates realised that the question was really testing them on the role of the mitochondrial membranes in aerobic respiration and we saw some good descriptions of the inner membrane in relation to the electron transport chain and ATP synthase. Only the more able candidates were able to make an appropriate comment about the proteins in the outer membrane; we were only after something simple such as allowing pyruvate through into the matrix.

*(b) The table shows the protein : lipid ratio of the inner and outer membrane of a mitochondrion.

| Membrane of mitochondrion | Protein : lipid ratio |
|---|---|
| inner | 3:2 |
| outer | 1:1 |

Explain the difference in the protein : lipid ratio of the inner and outer membrane of a mitochondrion.

(6)

The protein : lipid ratio is much higher in the inner membrane over the outer membrane.

Respiration (aerobic) takes place in the mitochondrion, ~~the krebs cycle and link reaction take place in the mitochondrial matrix while~~ the ~~outer~~ inner membrane has the electron transport chain. Both membranes use lipids in order to form the membrane - seen by the fluid mosaic model. The inner membrane will have a higher ratio of proteins as ~~than~~ the electron transport chain requires many $H^+$ carriers made of protein, as well as ATP synthase, which is an enzyme - made of protein. In contrast, the outer membrane has equal portions of protein and lipid as carriers need to be present for the link reaction to carry the products of glycolysis in the cytoplasm to the kreb's cycle in the matrix. carriers are also present for the release of $H_2O$ and $CO_2$. The inner membrane needs to accommodate this as well as the electron transport, explaining why there is a higher ratio of proteins.

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Examiner Comments

This response was very close to being awarded 5 marks but we felt that 'the products of glycolysis' was too vague at this level.

**ResultsPlus**
**Examiner Tip**

Always be as specific as you can. Here for example, you are supposed to know the products of glycolysis that enter the mitochondria; therefore they should be named.

*(b) The table shows the protein : lipid ratio of the inner and outer membrane of a mitochondrion.

| Membrane of mitochondrion | Protein : lipid ratio |
|---|---|
| inner | 3:2 |
| outer | 1:1 |

→ ETC proteins
→ harder for pyruvate
→ easier for passage of ATP, ~~NADH~~, Pyr ~~Acetyl CoA~~ pyruvate

Explain the difference in the protein : lipid ratio of the inner and outer membrane of a mitochondrion.

(6)

The outer membrane has a lower protein : lipid ratio as it needs to be able to let through pyruvate, a large molecule, from glycolysis as well as NADH.
The inner mitochondrial has a larger protein : lipid ratio due to the channel proteins of the electron transport chain which are present. It also has ATP synthase for the production of ATP from a hydrogen concentration gradient. The inner membrane needs to be less permeable to create these concentration gradients
The proteins present in both can also be used for facilitated diffusion and lipid are from the phospholipid bilayer forming the mosaic structure.

**ResultsPlus**
**Examiner Comments**

This response has made it into level three but lacks detail to be awarded the full 6 marks.

**ResultsPlus**
**Examiner Tip**

The trick with these levels-based questions is to answer the whole question. A little about a lot will score higher than a lot about a little.

The inner membrane of the mitochondrian is the site of oxidative phosphorylation. and it is where the electron transport chain is found. The electron transport chain consists of proteins that ~~all~~ accept (and lose) electrons from NADH and $FADH_2$ in respiration (in a series of redox reactions). ~~There is oxidative phosphorylation of all~~ There are also proteins that actively pump $H^+$ ions into the intermembrane space to create a concentration gradient. ATPase is another protein found on the inner membrane that allows $H^+$ ions to diffuse down a concentration gradient, ~~phosphorylating~~ catalysing the phosphorylation of ~~ATP~~ ADP (into ATP) in the process. The outer membrane is not part of oxidative phosphorylation and so does not need all the proteins ~~used~~ found on the inner membrane.

**ResultsPlus**
**Examiner Comments**

Another example of a good level two response. The candidate has attempted to say something about the outer membrane proteins but it is too vague.

the inner membrane of the mitochondrion showed a greater protein:lipid ratio of 3:2 (1.5) as compared to 1:1 (1) in the outer membrane. The inner membrane has more proteins and lipids because it is a phospholipid bilayer which is composed of two phospholipid layer with hydrophobic tails and hydrophilic heads with carrier proteins intracellularly and extracellularly to transport molecules in and out of the mitochondrion. The outer membrane has a ~~large~~ large surface area, thin diffusion pathway and steep concentration gradient so molecules can easily diffuse out if they're small enough. It prevents large molecules from leaving the cell.

**ResultsPlus**
**Examiner Comments**

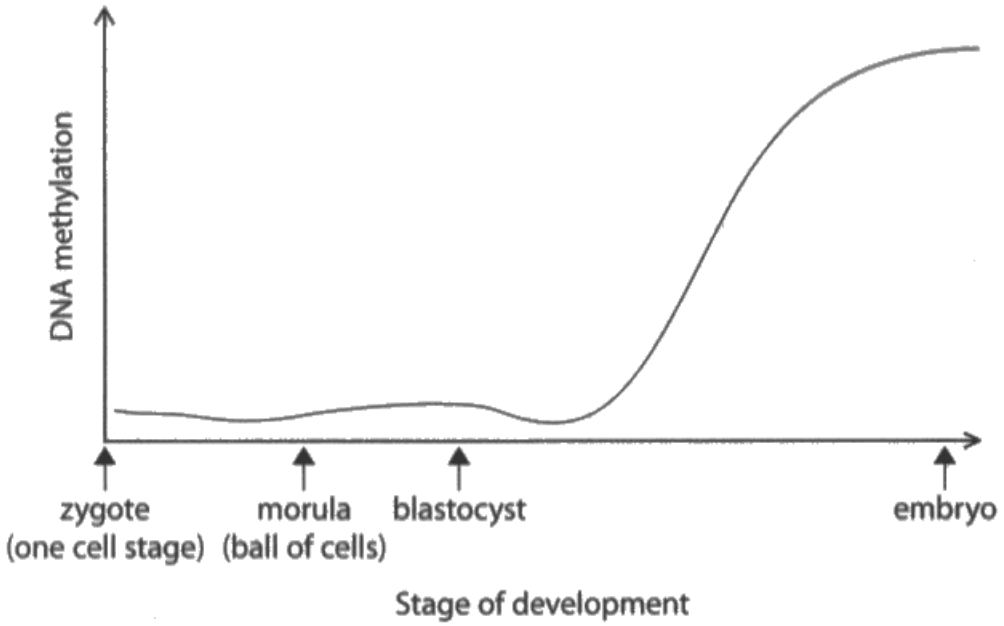
This is an example of a good level one response. This candidate has demonstrated knowledge of the structure of membranes but has not linked their response into the context of the mitochondria.

## *Question 5 (a) (i)*

Candidates understood the term methylation but could not tell us precisely where the methyl group was attaching to on the DNA.

**5** (a) Epigenetic modifications are involved in the development of an embryo.

The graph shows the changes in DNA methylation during the development of an embryo from a zygote.




(i) State the meaning of the term DNA methylation.

**(1)**

DNA methylation is the addition of a $CH_3$ group onto the CpG site of DNA.

**ResultsPlus**
**Examiner Comments**

A good illustration of what we were expecting to see.

**ResultsPlus**
**Examiner Tip**

We can ask you the meaning of any term that appears in the specification. It is a good idea therefore to build up a glossary of terms.

is when a methyl group is added to a cytosine [redacted], silencing the gene. (form of epigenetics) Preventing transcription + translation.

ResultsPlus
Examiner Comments

More detail than necessary to answer the question but still scores the mark.

## *Question 5 (a) (ii)*

A range of responses were seen in this question, ranging from some poor definitions of the terms to eloquent definitions that referred to the three stages of embryo formation. One misconception that a number of candidates hold is that you only get multipotent stem cells in an adult.

(ii) Describe the differences between totipotent, pluripotent and multipotent stem cells during the development of an embryo.

**(3)**

The early development of an embryo begins with totipotent cells which are undifferenciated, with the potential to form any type of cell. This forms the cleavage of a cell the embryo. As the embryo develops, ~~Pluripotent~~ totipotent cells begin to differenciate ~~at~~ depending on their location in the blastocyst, this decreases their potential to differenciate and forms pluripotent cells that can still differenciate, but not ~~not~~ into ~~everything~~ everything. Multipotent cells eventually form as the later stages of the embryo formation, these cells are very limited in the type of cell they can form, decreasing their level of differenciation.

ResultsPlus
Examiner Comments

This example illustrates how we were expecting the candidate to define the terms, using the graph.

Totipotent stem cells ~~can't~~ can differentiate into any cell type. Pluripotent stem cells can become ~~not~~ a wide variety, but not all, cell types. Multipotent stem cells can become few cell types including plasma cells in blood.

**ResultsPlus**
**Examiner Comments**

This candidate knows the difference between the three types of stem cells but has not referred to the embryo or graph. This was awarded the additional guidance mark.

**ResultsPlus**
**Examiner Tip**

If there is a context to the question then you must refer to it in your answer. There is no reference to an embryo in this response. It is the answer to the question: state the meaning of the terms totipotent, pluripotent and multipotent stem cells.

## *Question 5 (a) (iii)*

Candidates knew that DNA methylation was involved in silencing genes and that genes were silenced during differentiation. Few referred to the graph in their response.

(iii) Analyse the graph to explain why DNA methylation is involved in the development of an embryo.

**(2)**

DNA methylation allows cells to start to differentiate, therefore if DNA methylation did not occur, an embryo would not be able to develop because the cells cannot develop into cells useful for a human. ~~Wh~~e That's why DNA methylation increases after a blastocyst, because an embryo couldn't occur without specialising cells.

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**Examiner Comments**

Two marks were awarded here.

The level of DNA methylation stays mostly constant until the blastocyst forms as in the blastocyst the cells are pluripotent. A small increase is due to placental cells forming. After the blastocyst the level of DNA methylation increases rapidly ~~until~~ as it develops into an embryo as cells are differentiating and specialising into specific cells types such as heart tissue etc as development continues.

**ResultsPlus**
**Examiner Comments**

Two marks are illustrated here.

**ResultsPlus**
**Examiner Tip**

If a question starts 'Analyse the graph to explain . . .' start your answer by describing what the graph shows and then give the explanation. An explanation must include terms like therefore, because, so that, in order to, as a result of.

## *Question 5 (b)*

Mixed responses were seen to this question; there was quite a lot of confusion with multipotent stems cells.

(b) Explain why some cells are not able to become other cell types.

(2)

because ~~they are~~ some cells are already specialised Such as red blood cells and epithelial cells. This means that it would ~~be~~ ~~they~~ impossible to change into another cell as they are already specialised

**ResultsPlus**
**Examiner Comments**

This candidate had the right idea but did not take their response far enough.

**ResultsPlus**
**Examiner Tip**

Always check that you have made as many statements as there are marks allocated to the question. This candidate probably thought that they had written enough but they have only said the same thing in two slightly different ways.

## *Question 6 (a)*

A range of responses were seen to this question. A good number of candidates knew that the antigen bound to the MHC but there was confusion as to whether the MHC was on the endothelial cells, T cells or macrophages. Some candidates thought that MHC was a type of cell.

(a) Explain why the scientist looked for the presence of MHC molecules on the endothelial cells, in Step 1.

**(2)**

All endo Antigens can only be presented on the MHC of the cell, so to and experiment is to check the ability of endothelial cells to present antigens.

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**Examiner Comments**

This response was awarded both marks.

## *Question 6 (b)*

Many candidates simply repeated the stem of the question, that irradiation prevented cell division. A significant number of candidates thought that newly formed cells would not have MHC on them and therefore would interfere with the investigation. Mark point 3 was rarely seen.

(b) Irradiation prevents cells from dividing.

Explain why the endothelial cells were irradiated in Step 2, before they were cultured with T lymphocytes and antigen.

**(2)**

This prevents the radioactive thymidine from being incorporated into the endothelial cells' DNA as they are no longer dividing. This gives a more accurate result as only thymidine within T lymphocytes are measured.

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**Examiner Comments**

This is not the clearest of responses but we felt that it was just clear enough for two marks.

The prevention of endothelial cells from dividing is important because, the scientist only wants the T-lymphocytes to take up the radioactive thymidine not the endothelial cell. When dividing, the DNA would replicate and the radioactive thymidine would be incoparated in to the ~~lymphocytes~~ endothelial cells, the

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**Examiner Comments**

This response is clearer.

## *Question 6 (c)*

A number of candidates scored the first mark but very few could express themselves specifically enough to be awarded the second mark.

(c) Explain why the T lymphocytes needed to be washed thoroughly in Step 4.

**(2)**

To remove any traces of ~~thymine~~ loose thymidine from them that had not actually been used in DNA synthesis and so would affect the level of radioactivity detected, so a higher reading could be recorded than actually was incorporated in DNA.

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**Examiner Comments**

We felt that this was clear enough for both marks to be awarded.

The T lymphocytes need to be washed thoroughly because radioactive thymidine may be on surface of cell which would make it appear as though the T lymphocyte has incorporated more radioactive thymidine than it has which would distract from the validity of the results and this accounts for most and ensures only radioactive thymidine in the cell's DNA is determined.

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**Examiner Comments**

This response was a bit verbose but the candidate has clearly got the right idea.

## *Question 6 (d) (i)*

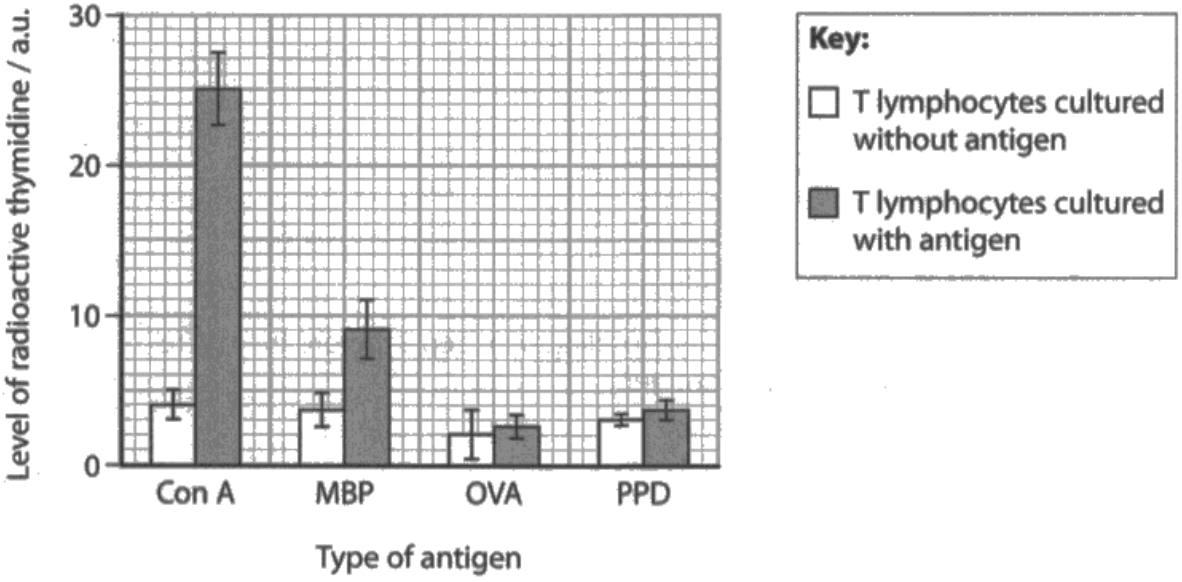
It was rare to see two marks scored for this question. Both mark points were seen but rarely together in the same response.

(d) In this investigation, the ability of the endothelial cells to present four different types of antigen was assessed.

T lymphocytes were cultured with endothelial cells and antigen.

This was repeated using T lymphocytes cultured with endothelial cells and no antigen.

The graph shows the results of this investigation.




(i) Explain why T lymphocytes were cultured with and without the antigen.

**(2)**

As this acts as a control group so researchers can see how much thymidine is taken into the lymphocyte when no antigen is present and so acts as a comparison group for the level of thymidine taken in when antigens are present too show the antigen presenting ability of the endothelial cells

**ResultsPlus**
**Examiner Comments**

This is an example of one of the rare responses that did score both marks.

The culture without the antigen acts as a control to observe the ~~number~~ level of radioactive thymidine incorporated into T lymphocytes without being stimulated (as some normal mitosis will still occur if no antigen binding). This means a comparison can be made to see if there is any difference in number of T cells produced when an antigen is present. Otherwise it would be impossible to tell whether the T cells have divided due to normal mitosis or because the endothelial cell has presented an antigen which the T cell has binded to.

**ResultsPlus**
**Examiner Comments**

We awarded this response two marks as well. We ignored the references to T cells dividing without antigen present as we felt what happens is a bit beyond the expectations of the specification.

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**Examiner Tip**

With questions of this nature, start your response in terms of the actual data being collected i.e. the effect on the uptake of thymidine and then extend your response to what this means in real terms i.e. the effect on the T cell.

## *Question 6 (d) (ii)*

Another question that elicited a range of responses. The less able candidates simply compared the uptake of thymidine with the different antigens, scoring additional guidance marks while the more able candidates picked up three of the available four mark points.

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

**(3)**

That the endothelial cells present the Con A antigen the best with 25 av. of radioactive thymidine, and that they are worst at presenting the OVA antigen at just 2.5 av. of radioactive thymidine. There is a difference between with and without the antigen in all results, so a conclusion can be drawn that endothelial cells could be ~~were~~ able to present all 4 antigens to some extent, although we can't say for certain on 2 of them as the error bars overlap, so further testing would be needed.

**ResultsPlus**
**Examiner Comments**

This candidate scored the first two mark points but it is not clear that the error bars are overlapping with the control data. This was a common mistake.

**ResultsPlus**
**Examiner Tip**

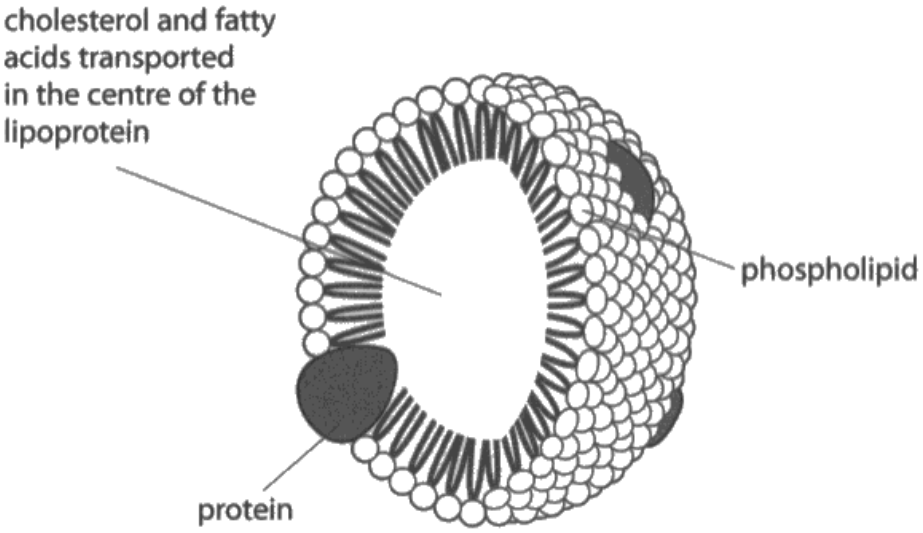
With questions of this nature, you should state the conclusions that can be drawn and then back them up with evidence in the data.

## *Question 7 (a)*

A large number of candidates could tell us that the phospholipids had hydrophilic heads and hydrophobic tails and quite a few could link the hydrophilic head with the lipoprotein being able to interact with the polar blood plasma. Fewer candidates could link the hydrophobic tails with the ability to carry the hydrophobic cholesterol or fatty acids. A number of candidates talked about the proteins acting as channels for the cholesterol to move into and out of the lipoproteins.

**7** High density and low density lipoproteins are spherical structures that transport cholesterol and fatty acids in the bloodstream.

The diagram shows a lipoprotein.




(a) Explain why the properties of lipoproteins enable cholesterol and fatty acids to be transported in the bloodstream.

**(3)**

The lipoproteins have a layer of phospholipid, where the ~~ph~~ hydrophilic ~~phos~~ phosphate heads face out towards the blood and water, and hydrophobic fatty acid tails face towards the centre of ~~the~~ the lipoprotein, which creates a waterproof barrier, so cholesterol can be carried to where it is needed. The intrinsic protein in the membrane allows cholesterol to enter/leave lipoprotein.

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**Examiner Comments**

This is one example, where the second and third mark points were awarded.

phospholipids (3)

~~B~~ Lipoproteins ~~assemp~~ assemble in a way where ~~phaspolipids~~ their hydrophilic ~~beed~~ head are on the outside which interacts with water, and their hydrophobic tails are on the inside causing an area with no water on the inside where cholestrol and fatty acids are able to transport in.

**ResultsPlus**
**Examiner Comments**

This is another example of mark points 2 and 3.

**ResultsPlus**
**Examiner Tip**

If there are three marks allocated for the question, you must make at least three points.

# *Question 7 (b) (i)*

Candidates who followed the instructions and used a value of 3.14 in their calculation and rounded up their value scored both marks. Candidates lost marks for giving decimal places in their answer or for not using the appropriate value for pi.

(b) The table shows some information about two types of lipoprotein, high density lipoprotein (HDL) and low density lipoprotein (LDL).

| Information about lipoproteins | HDL | LDL |
|---|---|---|
| density range / g cm$^{-3}$ | 1.063 to 1.210 | 1.019 to 1.063 |
| typical diameter / nm | 8 | 22 |
| typical volume / nm$^3$ | 268 | 5572 |
| percentage of protein (%) | 50 | 20 |

(i) Complete the table to show the volume of a typical LDL using the formula:

$\frac{4}{3}\pi r^3$ where $\pi = 3.14$

$r = 11$ (2)

$\frac{4}{3} \times 3.14 \times r^3$

$\frac{4}{3} \times 3.14 \times 11^3 = 5572.453$

ResultsPlus
Examiner Comments

A well laid out calculation.

ResultsPlus
Examiner Tip

Always show your working as you may pick up method marks even if you get the answer wrong.

## *Question 7 (b) (ii)*

(ii) Analyse the information to explain why LDLs have a lower density range than HDLs.

**(2)**

LDL's have larger diameter ∴

- LDL's have lower % of protein which is more dense than phospholipids
- ∴ as 30% less, density range will be lower.

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**Examiner Comments**

This candidate scored the first two mark points.

## *Question 7 (b) (iii)*

The answers to this question were disappointing. Some candidates thought that the lipoprotein would damage the endothelial cells but this would not have prevented access to subsequent mark points if the response had been written accurately enough.

**(iii) Explain why raised levels of LDLs may increase the risk of heart disease.**

**(4)**

Raised levels may increase the risk of heart disease as LDLs have a higher proportion of lipids compared to proteins than HDLs do. Therefore, this may encourage the formation of plaques in the artery and blockages, increasing the risk of heart disease. LDLs have a higher volume which increases the amount of cholesterol and fatty acids that can be transported in the blood stream. This means that there is more chance that a plaque or blockage can form leading to a narrowing of a blood vessel.

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**Examiner Comments**

This scores two marks.

**ResultsPlus**
**Examiner Tip**

Avoid expressions such as fatty deposits, hardening of the arteries and preventing blood flow to the heart. We want cholesterol building up, blocking flow of blood to heart **cells**. Also, you must make it clear that these events are occurring in the arteries.

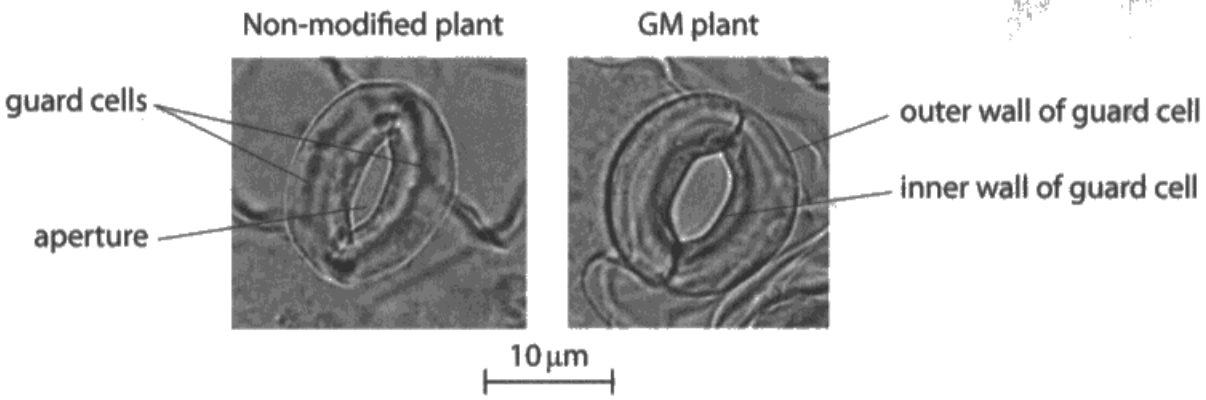
# *Question 8 (a) (i)*

Some candidates struggled with this calculation whereas others did not read the instructions carefully enough and did not express their answer in standard form.

**8** Genetically modified (GM) crop plants have been produced that have stomata with a wider aperture than non-modified crop plants.

This difference in the width of the aperture is only evident in daylight.

The photographs show the appearance of each type of stoma in daylight.




Sourced from: http://www.aip.nagoya-u.ac.jp/en/public/nu_research/images/Wang_f1.jpg

(a) (i) Calculate the magnification of the GM plant photograph using the scale bar.

Give the answer in standard form.

(2)

I
A M

Image = 17 mm = 17000 µm

Actual = 10 µm : 10 µm

17000 / 10 = 1700

Std form = $1.7 \times 10^3$

1700

Answer $1.7 \times 10^3$ ~~1700~~ x

**ResultsPlus**
**Examiner Comments**

This candidate came up with the correct answer and expressed it as required.

ResultsPlus
Examiner Tip

Read the question carefully and follow the instructions.

## *Question 8 (a) (ii)*

This calculation did not cause too many problems unless the candidates selected too many decimal places or put units in after their numeric answer.

(ii) Calculate how many times wider the aperture of the stoma of the GM plant is compared with the stoma of the non-modified plant.

(1)

Non modified = 3mm

GM = 7m

$\frac{7}{3} = \times 2.3$

Answer x 2.3

**ResultsPlus**
**Examiner Comments**

This value was within range.

**ResultsPlus**
**Examiner Tip**

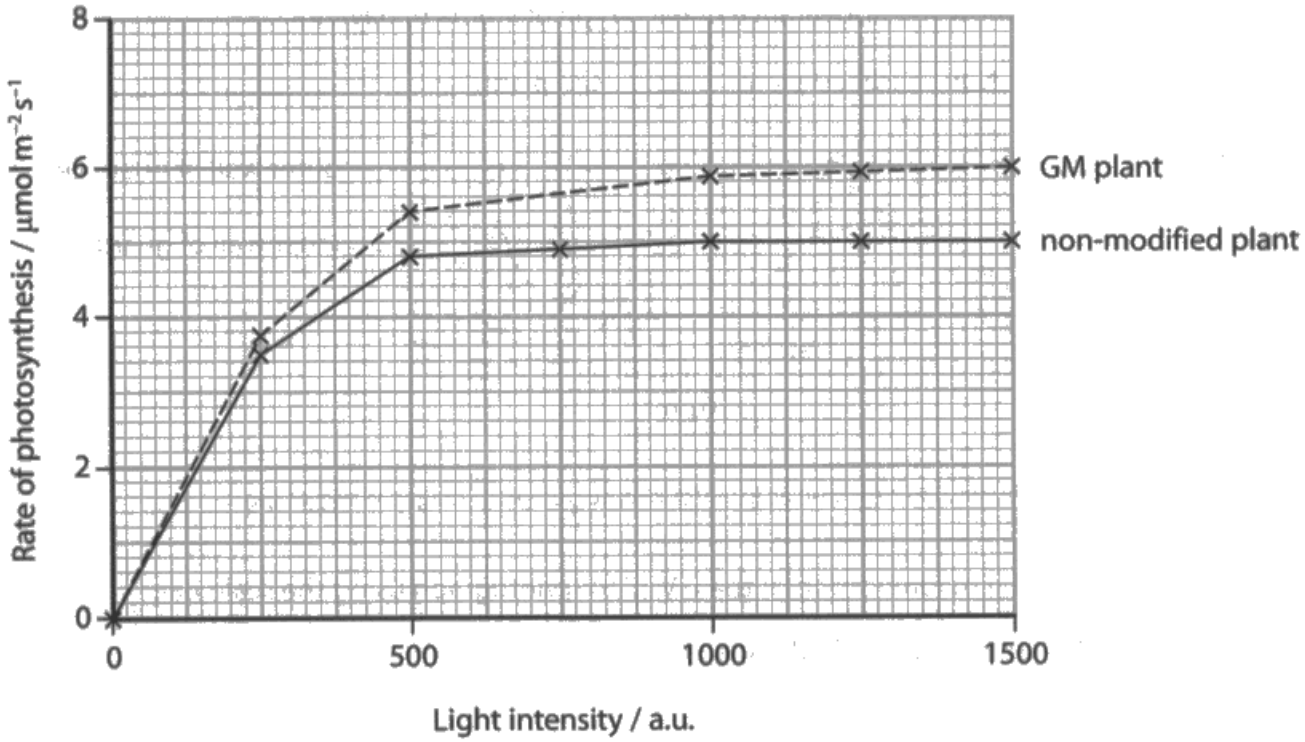
Ensure that you give units if required but similarly do not give them if they are not required.

## *Question 8 (b) (i)*

This was not answered particularly well, despite it having been answered before in a previous series. The most frequently seen mark point was the first one.

(b) An investigation was carried out to compare the effect of light intensity on the rate of photosynthesis in GM plants with the effect in non-modified plants.

The graph shows the results of this investigation.




(i) The rate of photosynthesis is expressed as µmol $m^{-2}$ $s^{-1}$.

Describe what was measured to find the rate of photosynthesis.

**(3)**

The amount of oxygen produced per $m^2$ of a leaf every second. The volume of oxygen could be found then converted to µmol and the surface area of the leaves of the plant scaled up. These are divided by each other then by the amount of the seconds the practical took place for.

**ResultsPlus**
**Examiner Comments**

One of the few responses we saw that scored all three marks.




Attempting past papers is a very good way to prepare for exams, and you never know when a similar question might come up.

## *Question 8 (b) (ii)*

This question scored reasonably well provided the candidates answered the question and wrote a comparative answer. There were an alarming number of candidates who seemed to think that the wider aperture enabled more light to penetrate into the leaf, thus increasing the rate of photosynthesis.

(ii) Explain the results of this investigation.

(3)

As light intensity increased, the rate of photosynthesis increased in both plants but to a greater extent - in GM plants. This is ∴ in GM plants the stomata open wider, so more carbon dioxide can diffuse in, so the rate of photosynthesis is higher. The rate of photosynthesis levels off for both plants when another factor becomes limiting or when all stomata are open. At this point the rate of photosynthesis is still higher for

**ResultsPlus**
**Examiner Comments**

This response is nice and clear but the lack of A level detail in the explanation prevented the third mark point from being awarded.

**ResultsPlus**
**Examiner Tip**

Remember you are sitting an A level exam and not a GCSE one; you need to include A level detail in your answers.

## *Question 8 (c)*

We saw mark point 1 frequently but few candidates extended their answer further. Candidates made comments about the wider stomata increasing transpiration in part (b)(ii) but did not consider the relevance here.

(c) Explain why the wider stomata in GM crop plants could increase their yield. (3)

GM crops have an increased rate of photosynthesis
No more $CO_2$ is able to enter the leaf so that more carbon fixation can occur in the light independent reaction of photosynthesis where glucose is produced. more of the glucose can be turned into complex carbohydrates to form plant structures such as cellulose or starch which contribute to a larger plant and a higher yield.

**ResultsPlus**
**Examiner Comments**

This candidate scored the first two mark points.

The wider stomata increase the rate of photosynthesis as they provide a larger surface area for gas exchange and help to maintain the concentration gradient of gases. This means that more GALP can be ~~sy~~ made more rapidly, which can be used to make glucose ~~for~~ the developing seeds, as well as ~~making~~ combining with nitrates to form amino acids or combining with phosphates to make nucleotides for the seeds so that the seeds are more plentiful and healthier, as many more proteins/structural materials ~~components~~ can be synthesised more rapidly and so more seeds can be produced.

**ResultsPlus**
**Examiner Comments**

This scored two marks as well. The right idea but not enough link to transpiration for a third mark to be awarded.

## *Question 9 (a)*

A range of responses were seen for this question. Most candidates scored their marks for explaining why the insertion of Dox into the molecule prevented division. Few candidates could not go further than explaining how inhibitors work so did not score the last point. There was quite a lot of confusion between DNA synthesis and transcription, with a number of candidates stating that mRNA had to be made prior to DNA synthesis.

**9** Doxorubicin (Dox) is a drug used to treat cancer.

(a) Cancer is caused when cells divide uncontrollably.

This drug works in two ways:

- it becomes inserted into the DNA and holds the two strands together.
- it binds to an enzyme that repairs DNA.

Explain how Dox prevents cancer cells from dividing.

**(5)**

- This is because it stops DNA replication and transcription. this occurs as bonds aren't able to break, so free nucleotides are unable to form new strands.
- It stop mitosis, as the chromosome are unable to separate during anaphase. Reducing the amount of cells dividing.
- By binding to the enzyme, it stops DNA being repaired, so some cells may die. (Apoptosis). This will reduce amount of cells. But not reduce amount dividing.

**ResultsPlus**
**Examiner Comments**

A reasonable response gaining three marks.

Holding the strands of DNA together will prevent DNA helicase from breaking the hydrogen bonds between them so DNA replication cannot occur. Binding to DNA ligase will prevent the enzyme from joining together the okazaki fragments on the lagging / antisense strand so the replicated DNA cannot be formed. Both prevent the process of DNA replication as well as transcription and translation so these cells cannot undergo mitosis / meiosis as the number of chromosomes in these cells will not increase during interphase.

**ResultsPlus**
**Examiner Comments**

An example of one of the better responses that we saw.

**ResultsPlus**
**Examiner Tip**

Ensure that you use all the information given in the question in your answer. You were given two facts about the action of Dox so you will not score full marks if you do not comment on both.

# *Question 9 (b) (i)*

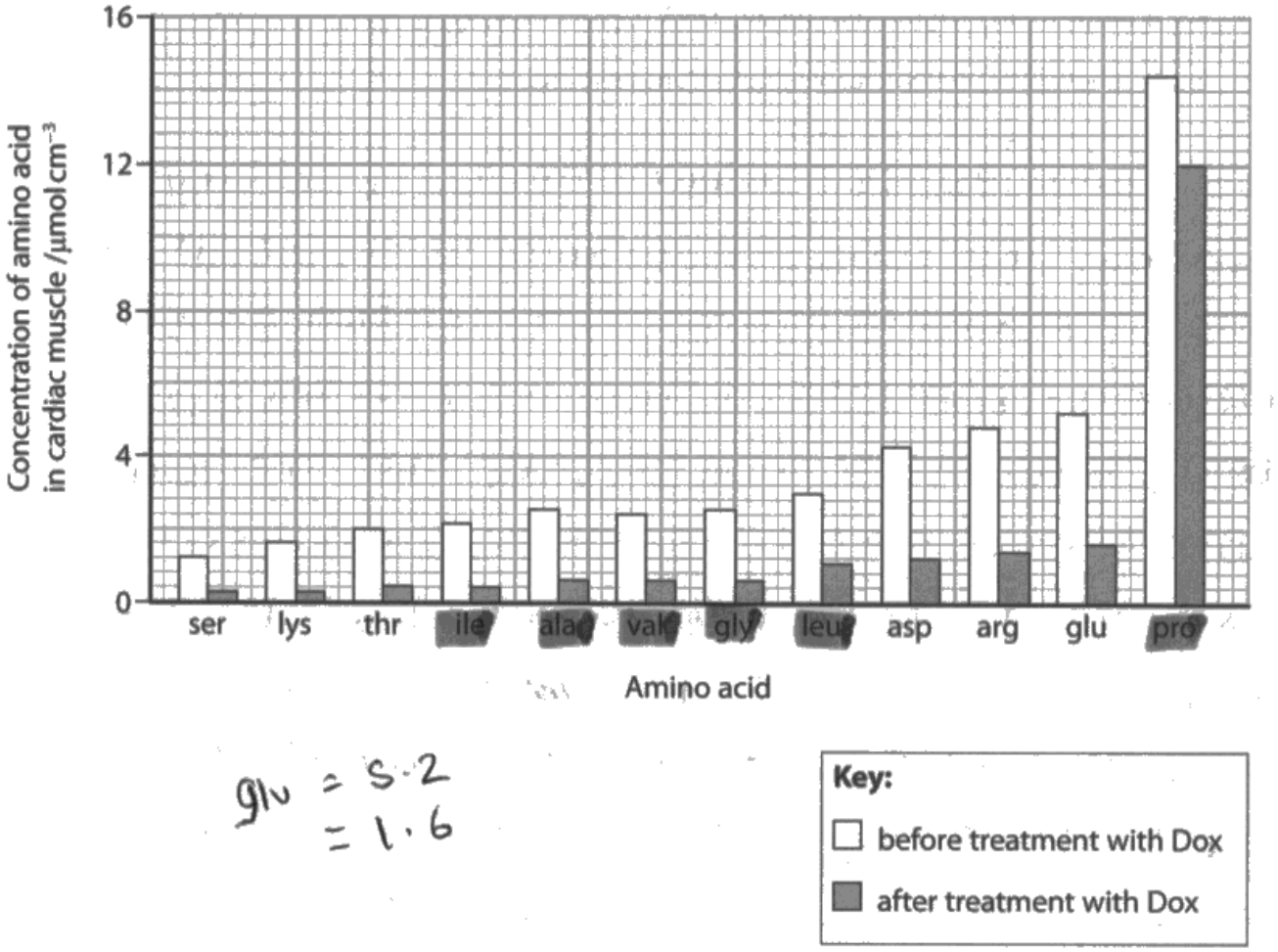
'Determine' is one of the new command words in this new specification and it was clear that candidates either had not been taught its meaning, or else had forgotten what is required. This command word expects at least one calculation to be made to arrive at the final answer. As this is a levels-based question, then a calculation is needed for each level (or superseded by a higher level calculation).

Many candidates picked out that the concentration of amino acids fell in the presence of Dox and a significant number realised that the polar amino acids were more affected. Very few candidates looked at individual amino acids within one of the two groups.

(b) Weakening of the cardiac muscle is one side effect of using Dox.

The effect of Dox on the concentration of several amino acids in cardiac muscle was investigated.

The graph shows the results of this investigation.




glu = 5·2
= 1·6

The table shows some non-polar and polar amino acids.

| Type | Amino acids |
|---|---|
| non-polar | ala, gly, ile, leu, pro, val |
| polar | arg, asp, glu, lys, ser, thr |

*(i) Analyse the information to determine the effect of Dox on the concentration of these types of amino acid in cardiac muscle.

(6)

When analysing the information in the graph, we can see that there is a reduction in the concentration of every single amino acid after treatment with Dox. ~~However~~ For example, before treatment, the concentration of thr was 2 $\mu mol\,cm^3$, whereas after treatment the concentration of thr was 0.4 $\mu mol\,cm^3$. However, I can also see that the reduction in the concentration of polar amino acids is greater than the reduction in concentration of non-polar amino acids. For example, pro was reduced by 2.4 $\mu mol\,cm^3$, whereas glu was reduced by 3.6 $\mu mol\,cm^3$. Thus, another conclusion that I can draw is that Dox reduces polar amino acids more than non-polar amino acids.

**ResultsPlus**
**Examiner Comments**

This is a solid level two response, gaining four marks.

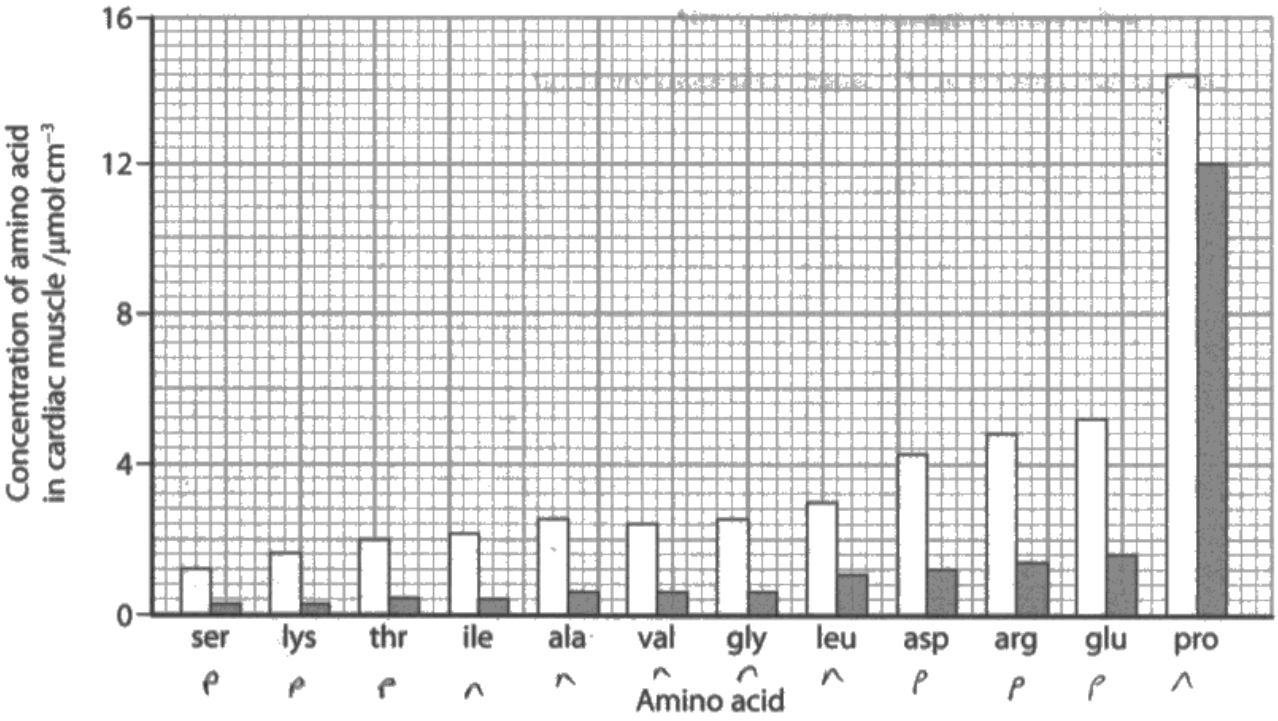
**ResultsPlus**
**Examiner Tip**

The command word 'determine' requires at least one calculation to be made. Check that you read values carefully from a graph and do the calculation correctly.

(b) Weakening of the cardiac muscle is one side effect of using Dox.

The effect of Dox on the concentration of several amino acids in cardiac muscle was investigated.

The graph shows the results of this investigation.




The table shows some non-polar and polar amino acids.

| Type | Amino acids |
|---|---|
| non-polar | ala, gly, ile, leu, pro, val |
| polar | arg, asp, glu, lys, ser, thr |

*(i) Analyse the information to determine the effect of Dox on the concentration of these types of amino acid in cardiac muscle.

(6)

Dox will decrease the concentration of all of the amino acids in the cardiac muscle. The amino acid pro has decreased in concentration but not as much as the others. It decreased from 14.4 μmol $cm^{-3}$ to 12 μmol $cm^{-3}$. ~~The Dox will~~ The decrease in the amino acid concentrations will cause less protein synthesis to occur so the cardiac muscle produces less ATP and is not able to repair as much. The ~~&~~ cardiac muscle will be unable to contract with as much force.

**ResultsPlus**
**Examiner Comments**

A good example of a level one answer, scoring two marks.

**ResultsPlus**
**Examiner Tip**

Always do a calculation; it is barely GCSE level to simply quote figures.

When doing these levels-based questions you must use all the information given to you, if you are to access the higher levels.

## *Question 9 (b) (ii)*

Very few candidates could go further than the first mark point and then repeating the stem of the question.

(ii) Explain why a change in the concentration of amino acids results in the weakening of cardiac muscle.

(2)

amino acids
are code for the production of
proteins.
if there is less amino acids their will be
less protein synthesis
haemoglobin is an conguiceted protein
with 4 polypeptide chain held by disulphide bonds.
if there is less protein synthesis there will be ✓ reduced haemoglobin
less O2 transport around the body including to the
cardiac muscle so it can't beat as fast. The myoglobin
store will be less.

ResultsPlus
Examiner Comments

One of the rare responses scoring more than one mark.

## *Question 9 (b) (iii)*

This question was not done too badly with a number of candidates picking up the first and third mark. Mark point 2 was alluded to by many candidates but vague references to the 'body' instead of 'cells' prevented the mark from being awarded in many cases.

(iii) Explain how weakening of the cardiac muscle could affect a person.

**(3)**

Weakening of the cardiac muscle could mean that the heartbeat isn't as strong and so less blood is pumped around the body. This can lead to further problems as the heart rate (and pressure on the heart) will have to increase and could lead to a stroke if not enough oxygenated blood reaches the brain.

**ResultsPlus**
**Examiner Comments**

This is a good illustration of the type of response that we were hoping to see.

· Breathlessness as heart cannot contract with sufficient force to deliver enough $O_2$ & glucose to cells (stroke volume decreases so cardiac output decreases)

· Weakness and weight loss due to decreased cellular respiration (due to lower supply of respiratory substrate to cells)

· Increased heart rate – as stroke volume decreases cardiac output decreases ∴ heart rate must increase to compensate.

ResultsPlus
Examiner Comments

Three marks in the first two lines. Nice and concise.

# Paper Summary

Based on their performance on this paper, candidates are offered the following advice:

- Candidates can still use papers from the previous specification to practice questions that cover topics common to both specifications.
- Candidates should be taught how to do the types of calculations that are listed in the specification and they should be taught how to recognise how many decimal places or significant figures should be given in their final answer.
- Candidates need to be aware of what is expected by each of the command words that are listed in the specification.
- Candidates need to be constantly reminded to write as many A level points as there are marks allocated to a particular question; using old specification past paper questions will be very useful in giving candidates this practice.
- Candidates need to be taught how to decide what needs to be included in a levels-based question to access the level three response marks; using both UK home specification papers and international new specification papers would help here as they include questions of this style.
- Candidates need to be prepared to answer questions on any part of the specification, however small the specification point appears to be.

# Grade Boundaries

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

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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