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A LEVEL

Examiners' report

BIOLOGY B (ADVANCING BIOLOGY)

H422
For first teaching in 2015

H422/03 Summer 2019 series

Version 1

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

Paper 3 series overview

The purpose of this written paper is to assess candidates' abilities to relate their practical experiences gained in their Centre to questions set in standard or applied contexts. Candidates who have gained a broad and detailed experience on all aspects of practical work are expected, and will, perform at higher levels.. Candidates are, as with all written papers, expected to be able to apply their knowledge and understanding in unfamiliar contexts such as relating them to a new procedure or comparing different procedures.

This session saw a rise in attainment by candidates and a development in their answering techniques, especially in the practical design type of questions e.g. Q3(b).

Note

From this series students have been provided with a fixed number of answer lines and an additional answer space. The additional answer space will be clearly labelled as additional, and is only to be used when required. Teachers are encouraged to keep reminding students about the importance of conciseness in their answers. Please follow this link to our SIU (https://www.ocr.org.uk/administration/support-and-tools/siu/alevel-science-538595/)

Question 1 (a)

1 A student was learning about the heart and circulatory system. The student dissected a heart and made a drawing of their dissection as shown in Fig. 1.1.

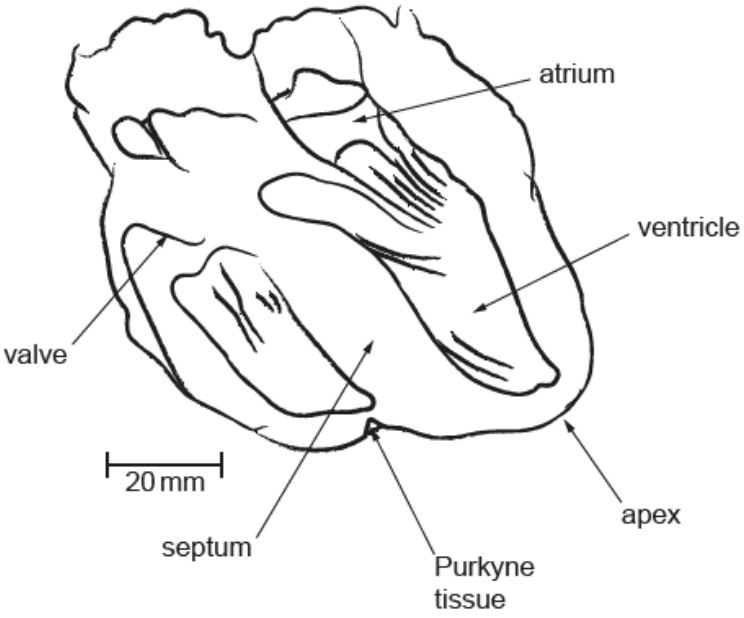


Fig. 1.1

(a) Suggest **two** improvements that could be made to the drawing in Fig. 1.1.

1 .....

.....

2 .....

.....

[2]

Generally this question was answered well. In some cases answers were not clear and could not be credited e.g. "add more labels", "make lines solid". Candidates should be aware that the command word was to suggest two improvements, so only the first 2 improvements will be assessed by examiners. Candidates who provide additional suggestions are at risk of contradicting their initial answers.

Question 1 (b)

(b) The student was given a microscope slide of a large artery. The image seen is shown in Fig. 1.2, **on the insert**.

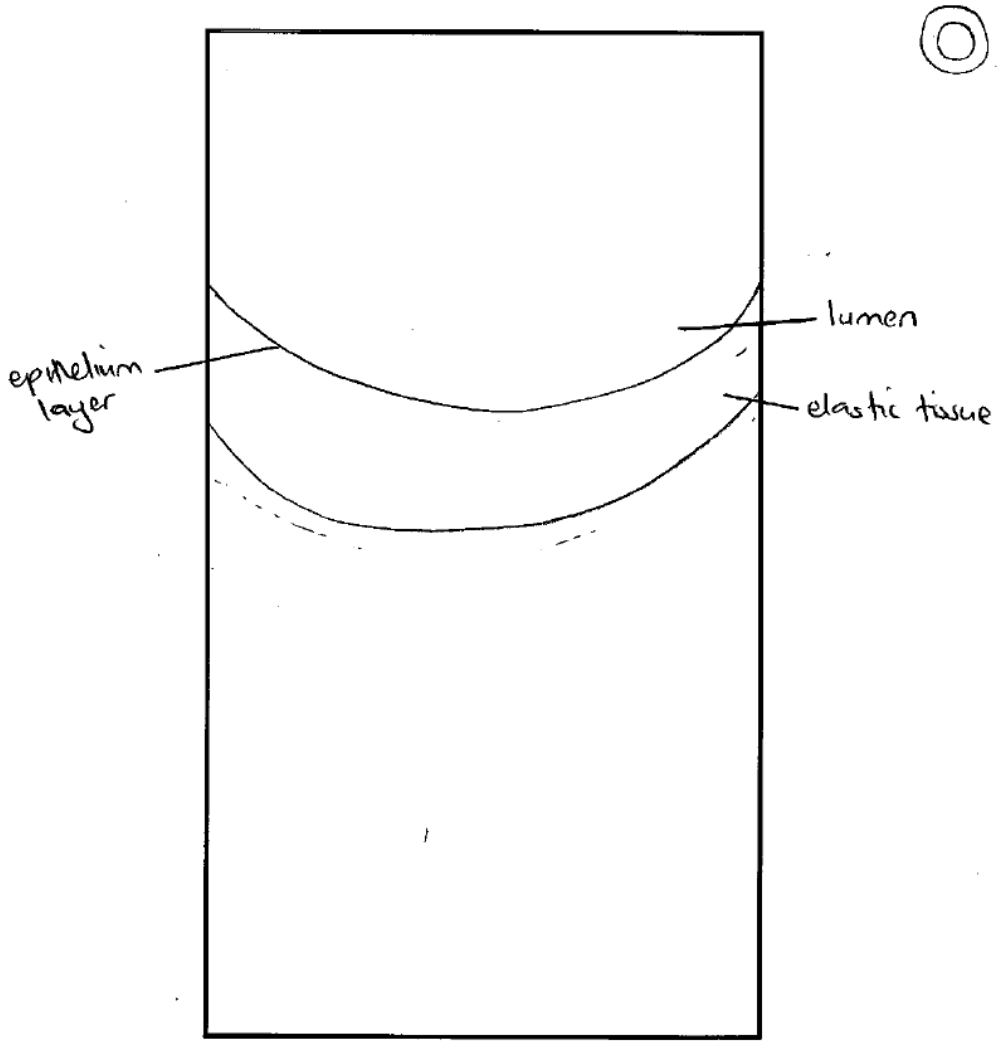
A small part of the image in Fig. 1.2 has been enclosed in a rectangle.

Using the space below, draw an annotated low power plan of the part of the artery shown within the rectangle in Fig. 1.2.

[4]

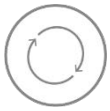
Candidates did not always follow their own advice from Q1(a) in terms of guidelines for biological drawings e.g. sharp pencil, ruled label lines. Some candidates did not draw the section that represented the area specified in the rectangle. Several candidates incorrectly labelled the areas in the low power plan and did not add suitable annotations. Some candidates merely drew two lines which did not allow them to identify the different areas of tissue within the section.

Exemplar 1



[4]

Exemplar 1 didn't score any marks. This was because the wrong section was drawn. This candidate has drawn an area which is outside of the rectangle. Although labels have been included, there are no annotations.

	**AfL**	When candidates are preparing biological drawings it is important to emphasise the difference between labels and annotations. Annotation adds concise notes about the structures labelled on a biological drawing. It is often used to draw attention to features of particular biological interest, either structural (such as shape, size and colour) or functional.

	**OCR support**	OCR Biological drawing booklet can be used to support drawings: https://www.ocr.org.uk/Images/251799-biology-drawing-skills-handbook.pdf

Question 2 (b)

(b) The table below contains information about some of the methods used for detecting cancer.

Complete the table by inserting the missing information.

Method used to detect cancer	What does the method involve?	Which parts of the body are examined?
Blood test	antibody test (ELISA)	blood
Mammography	low energy x-rays	.....
CT scan	.....	whole body scans
.....	high frequency sound waves	soft tissue
MRI scan	..... field and ..... waves	soft tissue, bone, brain or spinal cord tumours
.....	radioactive tracer and gamma waves	produces three-dimensional images of any part of the body
Biopsies	needle, scalpel or speculum	tissues identified as possible tumours

[5]

This question was generally answered well with many candidates gaining full marks. Common mistakes in those that did not gain full marks were:

a) to not specify ***breast*** tissue for the mammograms, and only to stipulate soft tissue

b) not specify radio waves for the MRI scans

Question 2 (c) (i)

(c) Fallopian tube cancer treatment often results in infertility. Patients whose treatment has resulted in infertility may be offered egg freezing and subsequent *in vitro* fertilisation (IVF) treatment at a fertility clinic.

Fertility clinics have different mean annual pregnancy rates. Table 2.1 contains some information about mean annual pregnancy rates in two clinics each treating 400 patients.

	Mean annual pregnancy rate (% embryos transferred)
Clinic A	23
Clinic B	16

Table 2.1

The standard deviation, *s*, for both means is 9.7.

The Student's *t*-test can be performed to compare the mean annual pregnancy rate at each clinic and determine if the two are significantly different from each other.

(i) State the null hypothesis for this test.

.....

..... **[1]**

Many candidates were able to correctly give a null hypothesis that included both 'significant differences' and the term 'mean'. Many more candidates demonstrated an understanding of what a null hypothesis is compared to previous years.

Question 2 (c) (ii)

(ii) Calculate the variance, s^2, for these means.

variance = ... **[1]**

In questions where the format of the numerical answer is not specified candidates should expect to give the answer in full. In this case the answer was 94.09 and with no instruction to round given in the question this is what was required. Candidates who rounded up they were not given credit.

Question 2 (c) (iii)

(iii) Calculate the *t* value for the data in Table 2.1.

Use the formula:

$$t = \frac{|\bar{x}_A - \bar{x}_B|}{\sqrt{\frac{s_A^2}{n_A} + \frac{s_B^2}{n_B}}}$$

Give your answer to **three** decimal places.

t = ... **[3]**

Many candidates gained full marks on this question by substituting the values into the formula provided. Those that rounded or gained the incorrect answer in Q2(c)(ii) were given error carried forward, as is usual. Some candidates appeared not to understand how to use the generic formula. For example, some candidates thought 'S^2_A' meant 'S^2 multiplied by A', rather than the variance ***for*** data set A. Other candidates didn't read the question carefully and hence did not give their answer to 3 decimal places.

Question 2 (c) (iv)

(iv) Critical values for degrees of freedom >100 are shown in Table 2.2.

Degrees of freedom	Level of probability		
	0.05	0.01	0.001
>100	1.960	2.576	3.291

Table 2.2

Using Table 2.2 and your answer to **(c)(iii)**, comment on the mean annual pregnancy rates for clinics A and B.

.....

.....

.....

.....

..... **[3]**

A number of candidates were confident with this question and were able to draw conclusions from statistical tests while using the data tables effectively. Some answers did not gain credit due to poor expression in the answer for example referring to the t-value and not qualifying if this was the calculated t-value or the critical t-value. In some cases candidates' knowledge of the t-test was lacking and candidates incorrectly stated the null hypothesis should be accepted and was due to chance.

i	**OCR support**	Mathematical skills statistics booklet can offer support when using t-test: https://www.ocr.org.uk/Images/338621-mathematical-skills-statistics-booklet.doc 'Maths for Biology' website can also be used in order to provide support on statistical tests: https://www.ocr.org.uk/subjects/biology/maths-for-biology/handling-data/

Question 2 (d)

(d) The stages in one type of IVF treatment are shown below:

1. Hormones are used to stimulate several follicles within the ovary to mature at the same time.
2. Follicles are collected from the ovaries and the oocytes removed.
3. These oocytes are mixed with sperm in a Petri dish.
4. After several days the oocytes are checked for fertilisation.
5. Any resulting embryos are left to develop in an incubator for two to five days.
6. One embryo is transferred into the uterus.

During this treatment:

- The typical number of oocytes collected during stage 2 is between 5 and 25.
- Approximately 50% of the oocytes collected will be fertilised during stage 3.
- Of the total number of oocytes collected during stage 2, about 25% will result in a healthy embryo.

Discuss the ethical issues raised by this type of IVF.

You should use the information provided in your answer.

.....

.....

.....

.....

.....

.....

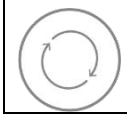
.....

.....

.....

..... **[4]**

A common misunderstanding in this question was for candidates to given generic points relating to all forms of fertility treatment and/nor not reading the information provided carefully enough. For example reference to multiple births (and or consequences of multiple births) is not relevant here as only one embryo was transferred (see step 6). Good answers considered issues that were both for and against the use of this form of IVF, but some candidates only focused on the negative issues. Candidates should always aim to give a balanced discussion in ethical based questions. In this question candidates were expected to quote the success rates of this form of IVF i.e. 23% and 16% success rates of the clinics (see information provided in Table 2.1 on page 5). Some candidates also gave their answer as a series of questions and as such left the examiner to decide if this was a comment in support of this form of IVF or against it; in these cases marks could not always be supported.

	**AfL**	In terms of examination technique candidates should also appreciate that if the question asks them to "use the information provided", they should quote data (if provided) to support their comment(s).

Question 3 (a)

3 A student was asked to find out the glucose concentration in mock body fluids. The student was provided with **three** samples. The student's plan contained the following apparatus list:

- test tubes
- 5 cm^3 syringes
- water bath set at 100 °C
- colorimeter fitted with a red filter
- cuvettes
- balance measuring in grams – 2 decimal place display
- filter papers and funnels
- table of data showing absorbance of 1, 5, 10 and 20 mmol dm^{-3} glucose solutions when tested with quantitative Benedict's reagent.

The student was given the choice of two methods, shown in Table 3.1.

Method 1 **Benedict's reagent**	**Method 2** **quantitative Benedict's reagent**
• Add 5 cm^3 of Benedict's reagent to a small volume of sample in a test tube. • Stand the test tube in boiling water for a few minutes. • Observe the colour change. A colour change from green to yellow, then to brown and finally to red indicates the presence of reducing sugar.	• Add 2 cm^3 of quantitative Benedict's reagent (QBR) to 4 cm^3 of sample in a test tube. • Stand the test tube in boiling water for 5 minutes. • Allow the tube to stand until the precipitate settles or filter to remove the precipitate. • Measure the absorbance using red light.

Table 3.1

The student chose to use method 2.

(a) Give **one** reason why the student chose method 2.

.....

..... **[1]**

This question was similar to Q1(a), whereas only the first reason suggested by the candidate was considered.. Many candidates referred to the fact that method 2 provided quantitative results. This was not credited as this information is provided to the candidates in the stem of the question. Only a few candidates were able to provide good answers such as method 2 being more objective/less subjective.

Question 3 (b)

(b)* Outline how the student could have used method 2 and the apparatus provided, to find out the glucose concentration in the samples of mock body fluids.

.....

..... **[6]**

Many candidates were able to achieve at least Level 1. There was evidence that some candidates may not have had experience using or observing how to use a colorimeter. As a consequence these candidates referred to placing the precipitate into the colorimeter and/or using test tubes, rather than cuvettes, into the colorimeter. In these cases the method was not deemed workable.

Most candidates included details of a risk assessment and the importance of collecting replicates to make sure repeatability. Some candidates described a method to produce a serial dilution of glucose solutions but then did not go on to say how the colorimeter would be used, and/or did not include details to show the intention of caring out the same QBR on all 3 mock samples so in effect did not actually generate any meaningful results.

High scoring answers demonstrated safe, repeatable and accurate methodology for example referring the zeroing of the colorimeter with distilled water, carrying our 3 replicates for each of the 3 mock body fluid samples and how to construct a calibration curve from the data table provided (see apparatus list final bullet point on page 8).

i	**OCR support**	Practical work should be an integral part of the study of Biology. The practicals provided by OCR to support the practical endorsement include Practical Activity Group (PAG) 5 in which there is practical activity on determining glucose concentration using colorimeter. PAG activities are available on OCR interchange: https://interchange.ocr.org.uk/Downloads/PAG5.zip It is acknowledged that not all centres will have access to colorimeters but there are several good video clips available online that can be used in these cases so candidates understand how and where this apparatus can be used.

Question 3 (c)

(c) A teacher was asked to comment on the method and results collected.

Complete the paragraph by choosing the most appropriate word from the list below.

anomaly **accuracy** **error** **limitation** **precision**

repeatability **reproducibility** **resolution**

The teacher suggested using a balance measuring in grams with a three decimal place display to improve ..... . After examining the results, the teacher concluded that the colorimeter had a zeroing error, limiting the ..... of the results. The teacher stated that one ..... of the investigation was that temperature was not controlled.

[3]

Most candidates scored at least one mark on this question with the most common correct answer being limitation. A common mistake was to use the term precision in the first gap which required the term resolution. For the purpose of this clarity in this question, precision is the '*closeness of agreement between (consistency, low variability of) measured values obtained by repeated measurements'*, which is not appropriate in this first gap.

	**OCR support**	Centres are strongly recommended to use the definitions of these key terms as per the specification which are based on the "Language of measurement" document published by the ASE and Nuffield Foundation used by all awarding bodies at both GCSE and GCE Level. Appendix 4 in the Practical Skills Handbook contains a list of definition of the most common key terms: https://www.ocr.org.uk/Images/294468-biology-practical-skills-handbook.pdf

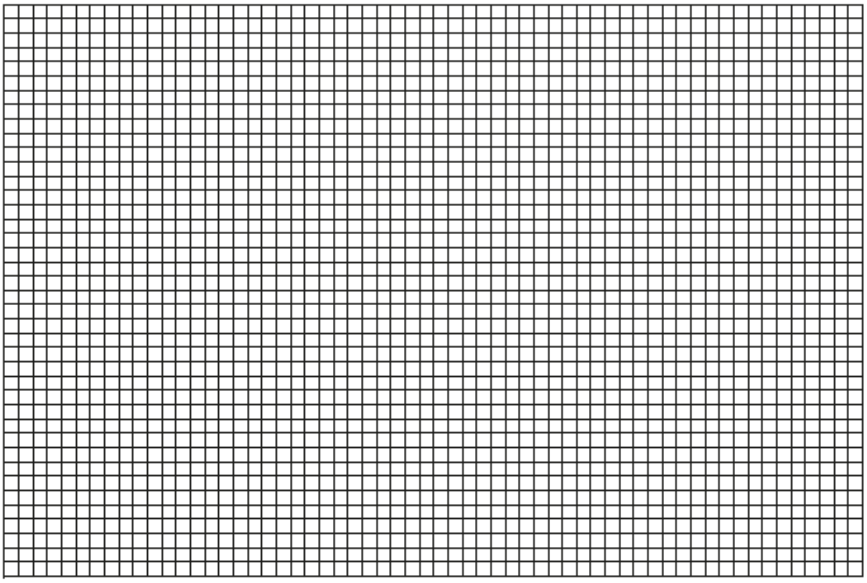
Question 3 (d) (i)

(d) The results of a similar investigation are shown in Table 3.2.

Location of body fluid sample	Mean concentration of glucose (mmol dm^{-3})	Standard deviation
Bowman's capsule	15	2.0
Proximal convoluted tubule	4	0.7
Distal convoluted tubule	3	0.5

Table 3.2

(i) Use the grid provided to present these data in the most appropriate way.



[4]

Many candidates gained 3 marks and often lost the final mark due to either drawing a histogram or a line graph rather than a bar chart. In some cases it appeared candidate were not used to using SD values to construct error bars. For example, some candidates incorrectly plotted the SD values on the x-axis and the mean glucose concentration on the y-axis. Centres should encourage candidates to use data to plot range bars and error bars and also to understand the difference between the two, where and why they should be used. Likewise the importance of using 'sensible' scales should be encouraged: some candidates used scales of 0.6 mmol dm^{-3} glucose for each small square on the y-axis which led, in some cases, to plotting errors.

i	**OCR support**	Math for Biology website contains a tutorial on how to select the appropriate graphical format: https://www.ocr.org.uk/subjects/biology/maths-for-biology/graphs/

Question 3 (d) (ii)

(ii) A student concludes that these data came from a diabetic person.

Select **one** piece of evidence to support this conclusion.

.....

..... **[1]**

Examination technique for this question was similar to Q1(a), whereas only the first reason suggested by the candidate was considered. Some answers were vague such as "the glucose levels are high in the Bowman's capsule" which is unqualified and therefore was not credited. Some candidates referred to the mean glucose level in the Bowman's capsule being above the expected normal range and quoted values for the normal range to support this point. Many candidates suggested that if selective reabsorption was efficient the mean glucose level in the distal convoluted tubule would be significantly less than that of the proximal convoluted tubule.

Question 4 (b)

(b) Fig. 4, **on the insert**, is a photomicrograph of a root meristem and its root cap. A fluorescent staining technique has been used.

- The cells in the root cap are constantly dying and being replaced by new cells.
- The cells about to die have enlarged vacuoles.
- These enlarged vacuoles appear red in Fig. 4.

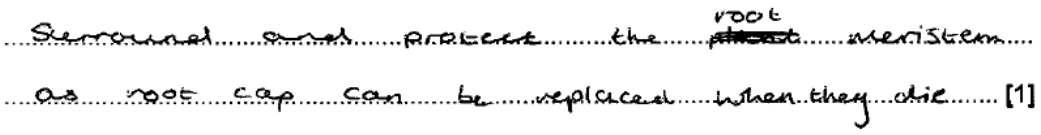
Suggest the benefit for the plant of having a root cap.

.....

..... **[1]**

This question was only answered correctly by a few candidates with many candidates giving irrelevant suggestions e.g. "increasing the surface area for water (and/or mineral ion) uptake" or answers that were too superficial e.g. "to protect the root".

Exemplar 2



This exemplar scored full marks. This was one of the very few acceptable responses.

Question 4 (c)

(c) A researcher examined two photomicrographs similar to that shown in Fig. 4 for seedlings of different ages. The total number of cells present in the root cap and the number of cells with an enlarged red vacuole were counted. The results are shown in Table 4.

Age of seedling (days)	Number of cells with an enlarged red vacuole	Total number of cells in root cap
5	12	40
10	.....	85

Table 4

The researcher concluded that there was a 33% increase in the proportion of cells with an enlarged red vacuole between day 5 and day 10.

Calculate the number of cells with an enlarged red vacuole on day 10.

Give your answer to **2** significant figures.

[Write your answer in Table 4] **[2]**

Only a few candidates were able to correctly calculate the number of cells with an enlarged red vacuole on day 10. Many candidates simply calculated the proportion of the number of cells with an enlarged vacuole to the total number of cells in the root cap and then repeated this for seedlings at day 10 and did not include a 33% increase in the proportion. Candidates should be encouraged to practice percentage increases and percentage decreases as a key mathematical skill.

The key steps were as follows:

Calculate the proportion of cells with an enlarged red vacuole at day 5: 12 out of 40 cells = 12÷40 = 0.3

Calculate a 33% increase in the proportion: 1.33 x 0.3 = 0.399

Calculate 0.399 of 85 cells: 0.399*85 = 33.915

Round answer to meet the same formatting of the numerical answer as that in the table i.e. 2 significant figures = 34

i	**OCR support**	Mathematical skills handbook can offer support on the calculation of percentage increase and percentage decrease: https://www.ocr.org.uk/Images/294471-biology-mathematical-skills-handbook.pdf There is a section on how to use ratios, fractions and percentages on page 12.

Exemplar 3

Age of seedling (days)	Number of cells with an enlarged red vacuole	Total number of cells in root cap
5	12	40
10	~~16~~ 34	85

Table 4

The researcher concluded that there was a 33% increase in the proportion of cells with an enlarged red vacuole between day 5 and day 10.

Calculate the number of cells with an enlarged red vacuole on day 10.

Give your answer to **2** significant figures.

=54

$12 \times 1.\frac{1}{3} = 16$

$\frac{12}{40} \times 1.\dot{3} = 0.4$

$\frac{3}{10} \times 33\%$

$0.39 \times 85 = 33.92$
$= 34$

$\frac{x}{85} = 33\%$

$\frac{12}{40} = 30\%$
↑ 33%
= 0.39 %

85×0.39
$= 33.9$
$= 34$

[Write your answer in Table 4] **[2]**

This is a very rare correct response. The candidate has correctly determined the proportion of cells with a red vacuole to the total number of cells. They have then addressed the second stage of the question which is to calculate a 33% increase in the proportion. This stage of the question was missed by many candidates.

Question 4 (d) (ii)

(ii) The group Eukaryota includes both animal and plant species. There are similarities and differences in the ultrastructure of cells found in animal and plant species.

Use a tick (✓) or a cross (✗) to complete the table below to compare the features of these cells.

Feature	Present in animal cells	Present in plant cells
Mitochondria	✓	✓
Golgi apparatus		
Tonoplast		
Ribosomes		
Cell wall		

[4]

The use of correct examination technique was important in this question. The instructions ask the candidates to **complete** table using ticks or crosses. In a number of cases candidates only used ticks and did not place a symbol in each cell. To that end they have not completed the table and as such did not gain credit (usually) for the Golgi apparatus and cell wall row. Although many candidates scored well in this question, a few seemed to think there were no Golgi apparatus and/or ribosomes in plant cells.

Question 5 (a)

5 Fig. 5, **on the insert**, is a photomicrograph of a human ovary. Structures within the ovary have been labelled, **A** to **F**.

(a) Using Fig. 5, complete the table below by identifying the structure or label that best fits the description.

Description	Structure	Label
Supplies blood to the ovary	central coiled blood vessel	**F**
Contains receptors on plasma membranes for FSH		**A**
Releases oestrogen	follicle	
Contains a haploid nucleus		**E**
Produces progesterone		**D**
Gel layer composed of glycoproteins	zona pellucida	

[5]

Identifying the label that best fitted the description was generally answered well with most candidates using C as the structure that released oestrogen and B for the gelatinous layer. However not many candidates identified the structures that had receptors for FSH, has a haploid nucleus or produces progesterone. In some cases candidates referred to Sertoli cells and sperm/spermatozoa which indicates they did not read the question carefully to note that the photomicrograph was that of an ovary.

Question 5 (b)

(b)* The appearance of an ovary changes with age.

A student observed the ovary in Fig. 5 and concluded that this ovary was from a woman who had not yet started menopause.

Analyse Fig. 5 and comment on this conclusion.

.....

.....

..... **[6]**

This question showed a range of answers from the very detailed and well-constructed to those that recalled facts about the menopause and did not relate the facts to observations seen in Figure 5.

It should be noted there are two aspects to this question. The first being that the candidate should identify features that can be **observed** (not learnt facts) in the figure that indicate if the woman has (or has not) started the menopause e.g. follicles are present in different stages of development, a large number (~20) of follicles present. The second, and often overlooked, aspect of the question is that candidates had to make a comment "on **this** conclusion". Examiners were looking for candidates to make direct reference to the students' conclusion and not make their own conclusion. This subtle difference was often not evident in answers. A few candidates made statements such as "I agree with the student's conclusion" or "I support the student's conclusion" or "I disagree with the student's conclusion". Both aspects of the question needed to be addressed to gain full access to Level 2.

i	**OCR support**	OCR 'Delivery Guides' on the effects of ageing on the reproductive system (4.2.2): https://www.ocr.org.uk/qualifications/as-a-level-gce-biology-b-advancing-biology-h022-h422-from-2015/delivery-guide/module-bb04-module-4-energy-reproduction-and-populations/delivery-guide-bbdg023-the-effects-of-ageing-on-the-reproductive-system-422

Exemplar 4

In support of the students statement;

- Fig 5 shows both maturing follicle cells and secondary oocytes which suggests that the women is still able to produce oocytes which can be fertilised by sperm.
- There is also a corpus luteum which only develops during the menstural cycle when stimulated by LH so would not be seen in a post menopausal women.

Against the students statement;

- Perhaps this women has fewer secondary oocytes then expected in a women who hasn't gone through menopause, so the ovarian scan could be compared. [6]

Additional answer space if required

to an ovary which definity hasn't gone through menopause.

* It is likely this women hasn't gone through menopause however it should be compared to other ovaries to confirm, the hormone levels of the women should also be found as this is significant evidence for menopause.

This is a good response and well-constructed. It was clear from this response that the candidate had addressed both parts of the question. In the first line they refer to the student's statement directly and then go on to also link evidence they have identified from the image (presence of maturing follicles and oocytes at different stages of development and the presence of a corpus luteum). This candidate also then recognises that one image is not adequate and indeed should be compared to other images such as those from an ovary of woman who is known to have not yet started the menopause. To that end the candidate has effectively analysed the image (and drawn appropriate conclusions from the structure present) and also commented on the conclusion (by demonstrating how it can both be supported but also assessing the confidence of such conclusions in the absence of further information).

Copyright information

Q3a, Fig. 3.1

Adapted from 'Benedict's test', www.mystrica.comv, Mystrica Practical Solutions.

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