Oxford Cambridge and RSA

Thursday 9 June 2022 – Afternoon

AS Level Biology B (Advancing Biology)

H022/02 Biology in depth

Time allowed: 1 hour 30 minutes

You can use:
- a ruler (cm/mm)
- a scientific or graphical calculator

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **24** pages.

ADVICE
- Read each question carefully before you start your answer.

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Answer **all** the questions.

1 **Fig. 1.1** shows a prepared slide of onion cells in different stages of mitosis, viewed using a light microscope.

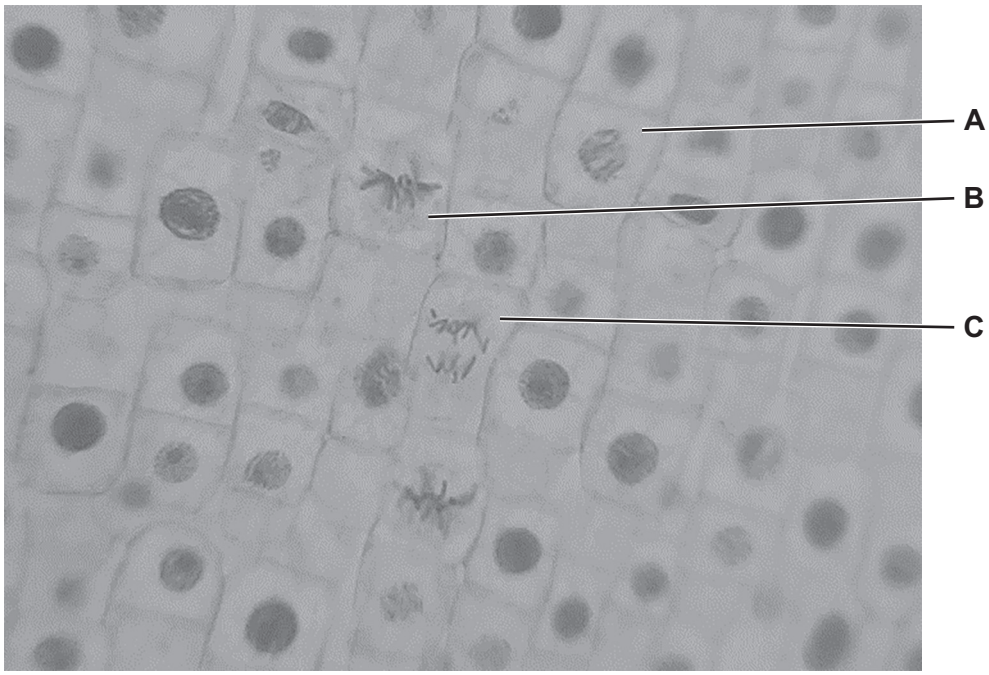

Fig. 1.1

(a) **(i)** Name the stages of mitosis taking place in cells **A** and **B**.

A .....

B .....

[2]

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(ii) **Fig. 1.2** shows a student's drawing of the cell labelled **C** in **Fig. 1.1**.

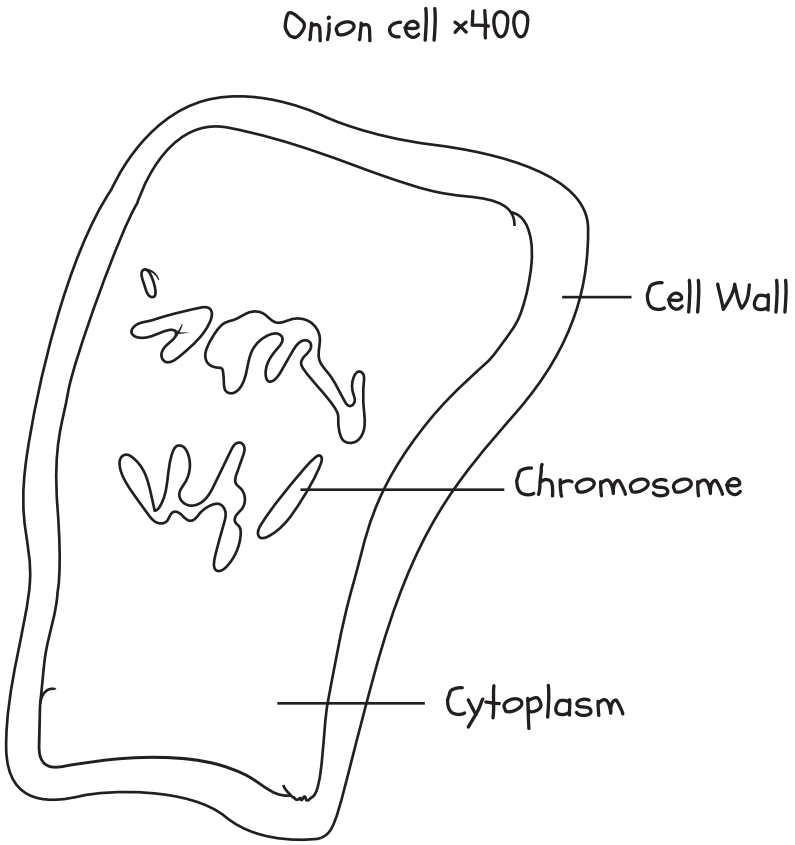

Fig. 1.2

Give **two** improvements the student could make to their drawing.

1 .....

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2 .....

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[2]

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(b) **Fig. 1.3** shows the cell cycle in an onion cell.

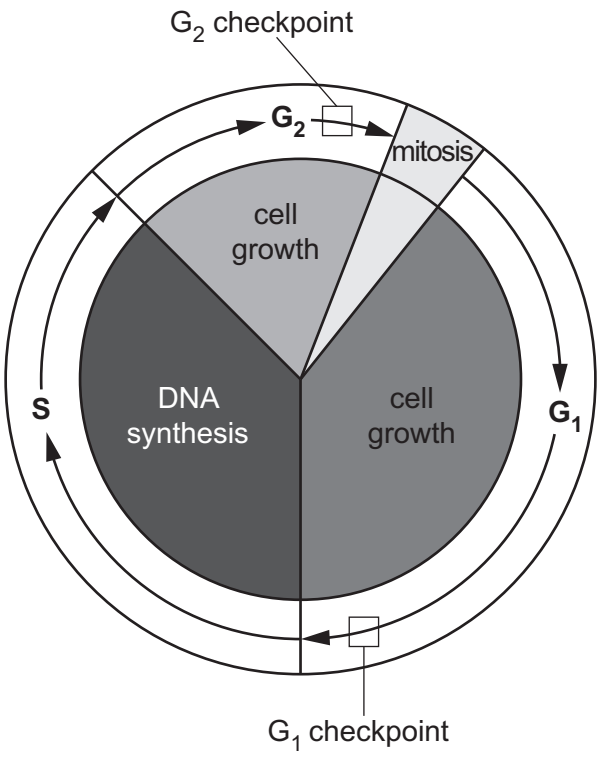

Fig. 1.3

Mitosis in an onion cell occurs once in 24 hours and lasts for 80 minutes.

Metaphase takes approximately 6.5 minutes to complete.

Calculate the percentage of the cell cycle which is spent in metaphase.

Metaphase = ... % **[2]**

(c) There are two main checkpoints in the cell cycle, the G_1 checkpoint and the G_2 checkpoint.

Explain how each of the checkpoints can ensure the cell develops normally.

G_1 .....

.....

G_2 .....

.....

[2]

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(d) The cell cycle is controlled by proteins. These proteins can initiate apoptosis.

Describe the sequence of events that occurs during apoptosis.

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

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2 Lenticels appear as small brown patches on the surface of some fruit.

A researcher wanted to investigate if water availability affected the number of lenticels on the surface of apples.

They chose nine apple trees of one variety and watered each tree with a specific volume of water every day for twelve weeks.

After twelve weeks they counted the total number of lenticels that developed on the surface of one apple from each tree.

This was repeated with a second variety of apple.

Fig. 2.1 shows the number of lenticels found on the surface of the two varieties of apple.

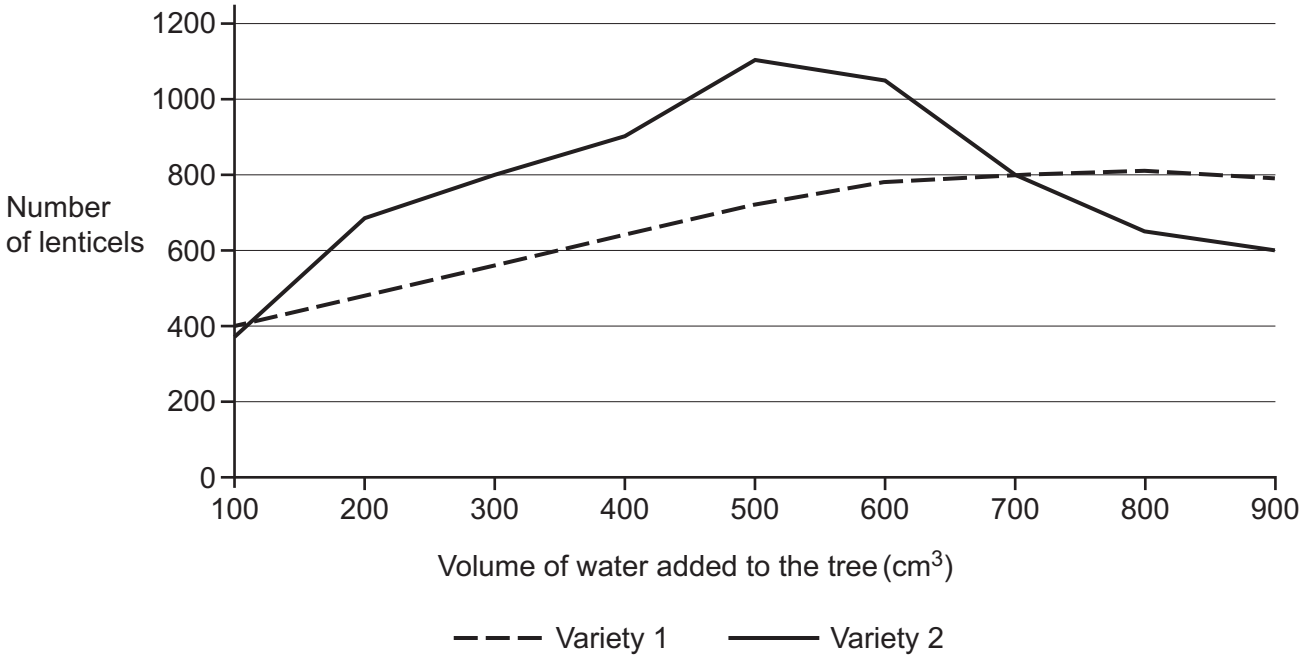

Fig. 2.1

(a) **(i)** Using **only Fig. 2.1**, what conclusions can be drawn about the effect of water availability on lenticel number for these two varieties of apple?

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..... **[2]**

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(ii) Another researcher suggested that:

'Adding a known volume of water to the tree is **not** a suitable method of investigating the effect of water availability on lenticel development.'

Evaluate this claim.

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

(iii) Explain why any difference in lenticel number shown in **Fig. 2.1** should not be described as a **significant** difference.

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..... **[2]**

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(iv) During this investigation, the trees were kept in a laboratory at 20 °C.

State **two** other variables that must also be controlled in this investigation **and** suggest how they could be controlled.

1 .....

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2 .....

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[2]

(v) The researcher compared the number of lenticels on apples of each variety. A more accurate method would be to compare the density of lenticels per apple.

Suggest how the researcher could measure lenticel density **and** explain why this would be a more accurate way to compare the effect of water availability on the two varieties. You can assume that the apples are spherical.

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..... **[2]**

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(b)* Compare and contrast gaseous exchange in stomata and lenticels.

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

Additional answer space if required.

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3 Tuberculosis (TB) is a disease caused by the bacterium *Mycobacterium tuberculosis*.

Fig. 3.1 shows the number of TB cases in the UK and the total population of the UK from 2001–2019.

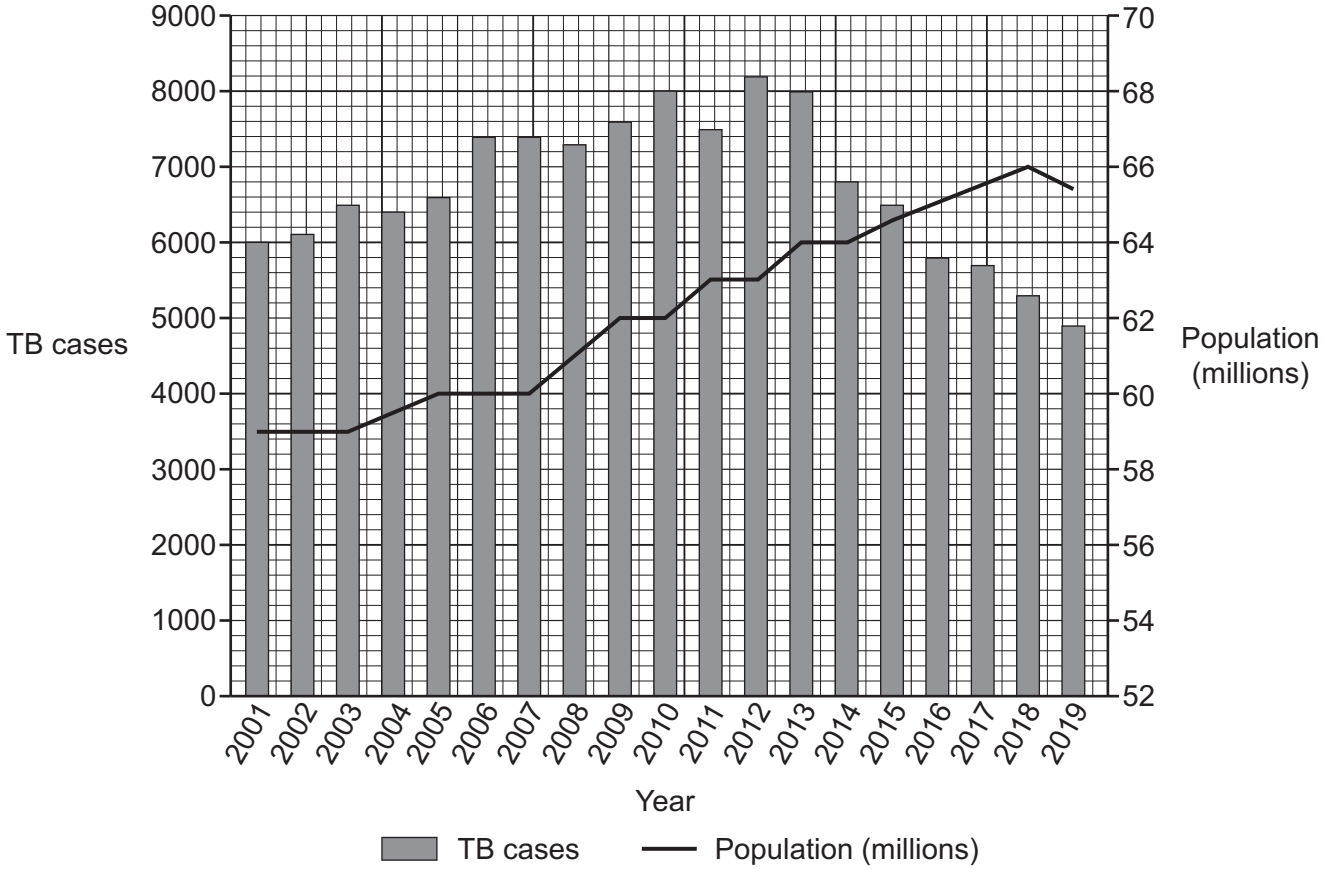

Fig. 3.1

(a) **(i)** Using **Fig. 3.1**, calculate the incidence rate of TB in 2018 per 100 000 of the population.

Incidence rate = ... per 100 000 people **[2]**

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(ii) Some people claim that TB will be eradicated from the UK by the year 2050.

Comment on whether the data in **Fig. 3.1** supports this claim.

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..... **[2]**

(b) TB is a notifiable disease and is reported to Public Health England (PHE).

State **three** ways that PHE can use data about the spread of TB to reduce the incidence of the disease.

1 .....

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2 .....

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3 .....

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[3]

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(c) Treating TB requires a long course of antibiotics.

Fig. 3.2 shows the outcome after 12 months of treatment with antibiotics, by sex and age, for a group of patients suffering from TB.

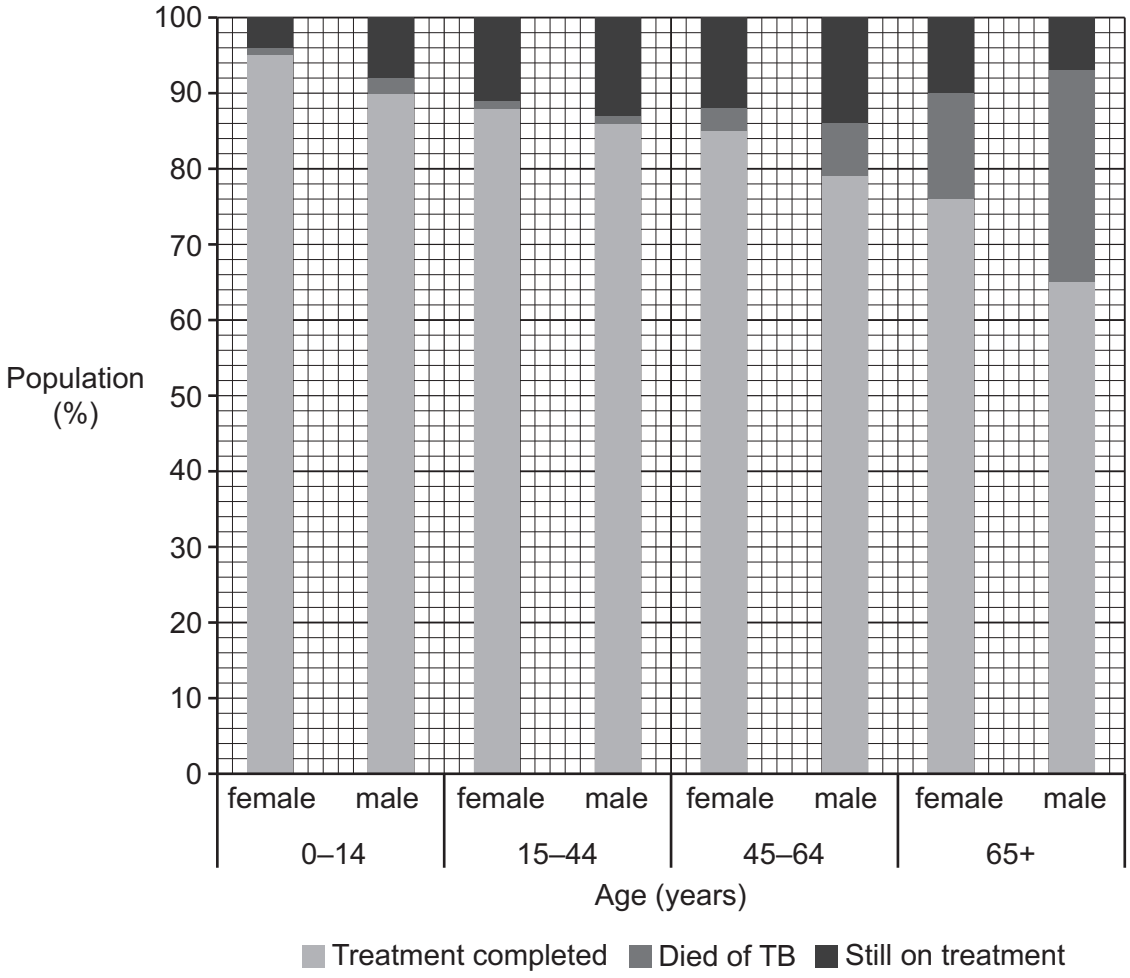

Fig. 3.2

(i) Calculate how many times more likely an individual aged 65+ is to die from TB compared to an individual aged 0–14 years old.

You can assume that the number of males and females is the same in each age group.

Likelihood = ... times **[2]**

(ii) Give **two** reasons why comparing age groups in this way may not be a valid method.

1 .....

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2 .....

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[2]

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4 In the first year of life, a baby will be given a vaccination against meningitis B.

There are two types of meningitis B vaccine. Both are inactivated vaccines.

(a) **(i)** Explain why it is not possible to contract meningitis B from an inactivated vaccine.

.....

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

(ii) There are currently no live vaccines for meningitis B.

Explain one advantage **and** one disadvantage of using a live vaccine.

Advantage .....

.....

Disadvantage .....

.....
[2]

(b) Give one reason for **and** one reason against giving vaccines to healthy babies when they are under one year old.

For .....

.....

Against .....

.....
[2]

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(c) **(i)** Some premature babies are unable to have the meningitis B vaccine.

Explain why it is important for premature babies that as many other babies as possible are vaccinated against the disease.

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

(ii) One reason that premature babies may not be given the meningitis B vaccine is that they can be born suffering from protein deficiency.

Babies born with protein deficiency may not be immune following vaccination.

Suggest why these babies may not be able to produce an immune response to the vaccine.

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..... **[2]**

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(d)* Scientists produce new vaccines for different communicable diseases every year.

Explain the potential problems faced by these scientists when developing new types of vaccine.

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

Additional answer space if required.

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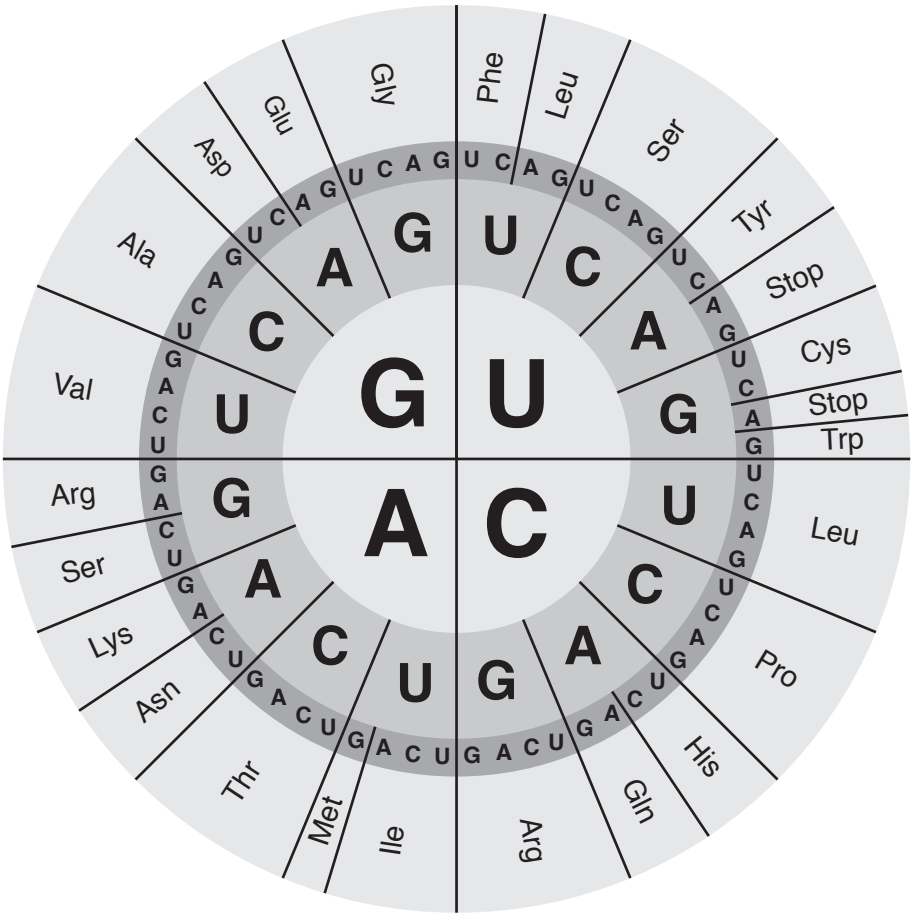
5 Amino acids are coded for by codons in the mRNA sequence.

The diagram shows the mRNA codons and the corresponding amino acids.



(a) The table below shows an mRNA sequence and some of the amino acids coded for by that sequence.

Complete the table with the correct amino acids.

mRNA sequence	A U G	G U G	C A C	C U G	A C U	C C U	G A G	G A G	A A G	U C U
Amino acids	Met	Val	His	Leu	.....	.....	Glu	Glu	.....	Ser

[1]

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(b) **(i)** Each amino acid is coded for by a 'triplet' code.

There are 64 different triplet combinations.

Explain how this number is calculated.

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..... **[2]**

(ii) Only 20 different triplet combinations would be required to code for the 20 amino acids commonly found in living organisms.

Explain what the remaining 44 combinations are used for.

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..... **[2]**

(c) Selenocysteine is an unusual amino acid that is coded for by the codon UGA.

It can be produced by *Escherichia coli* (*E. coli*) when grown in the absence of sulfur atoms and in the presence of selenium atoms.

Suggest the likely effect on a protein made by *E. coli* if the conditions are right for selenocysteine formation.

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..... **[2]**

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6 **Fig. 6.1** shows the structure of a phospholipid.

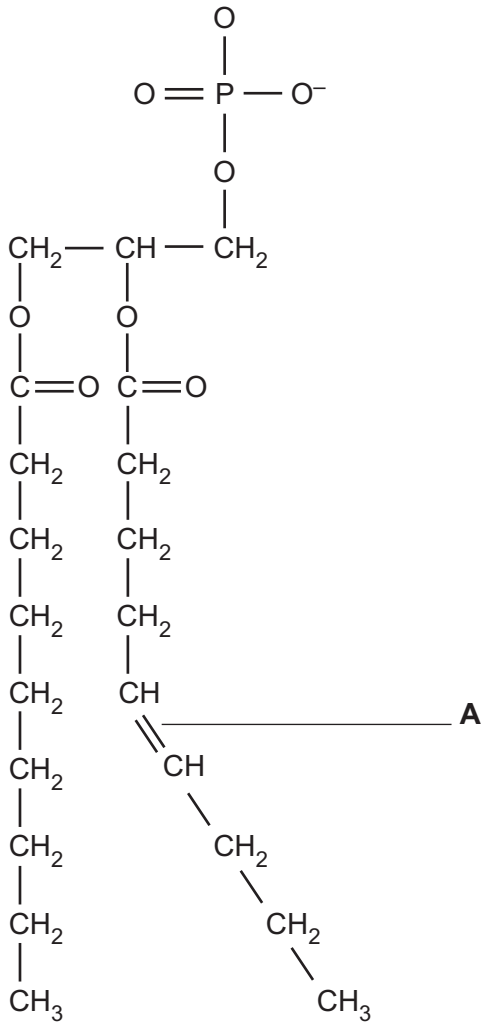

Fig. 6.1

(a) **(i)** Draw a box **on Fig. 6.1** around the region of the phospholipid that is glycerol. **[1]**

(ii) Label **A** in **Fig. 6.1** shows a double bond between carbons.

Describe the effect this double bond between carbons has on the properties of this molecule.

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

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(b) **Fig. 6.2** shows the percentage mass of two different lipids found in eukaryotic membranes.

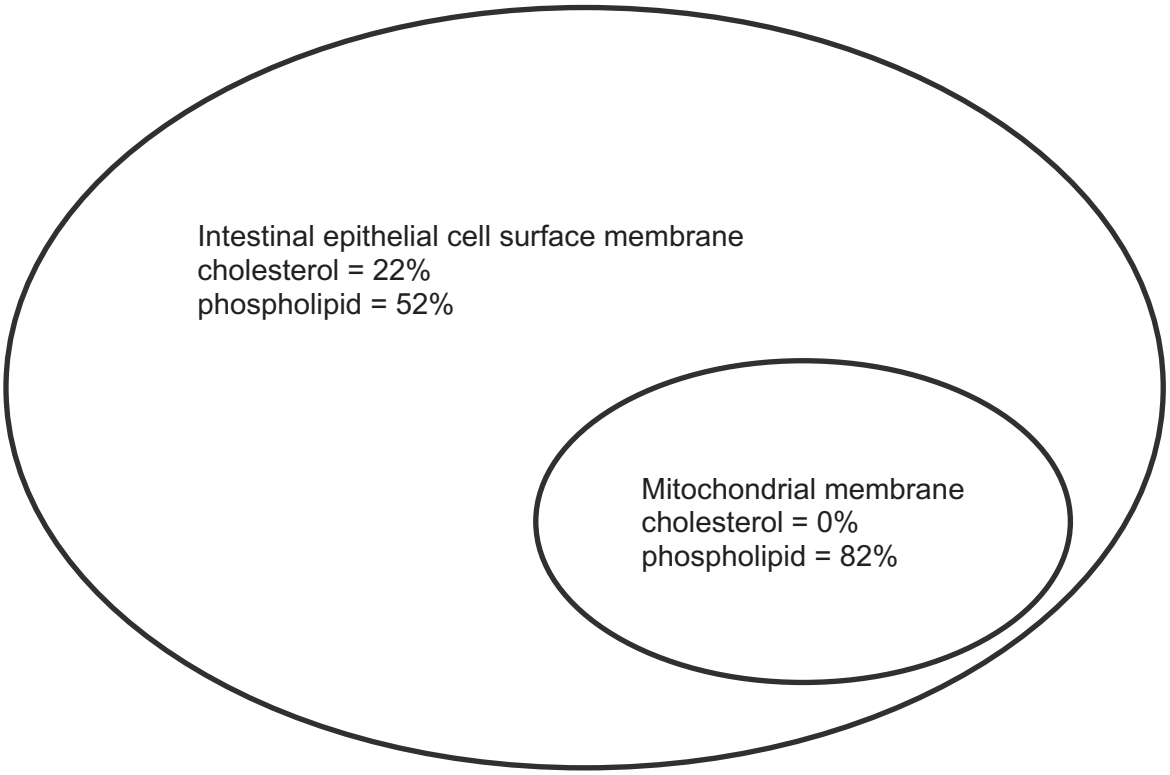

Fig. 6.2

(i) Explain why the cell surface membrane of an intestinal epithelial cell contains cholesterol but the mitochondrial membrane does not.

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..... **[2]**

(ii) Counting the number of each type of lipid molecule would be too difficult to do accurately.

Suggest **one** other reason why calculating the percentage mass of the lipids would be more accurate than counting the number of each type of lipid molecule.

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

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(c) The rate of active transport of a molecule across a membrane is dependent on a number of different factors.

State **and** explain **two** factors that can increase the rate of active transport across a membrane in the epithelial cell.

1 .....

Explanation .....

.....

2 .....

Explanation .....

.....

[4]

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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