Oxford Cambridge and RSA

# Thursday 22 May 2025 – Morning

## AS Level Biology B (Advancing Biology)

**H022/02** Biology in depth

**Time allowed: 1 hour 30 minutes**

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

*1327884794*

*H022202*

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.

1

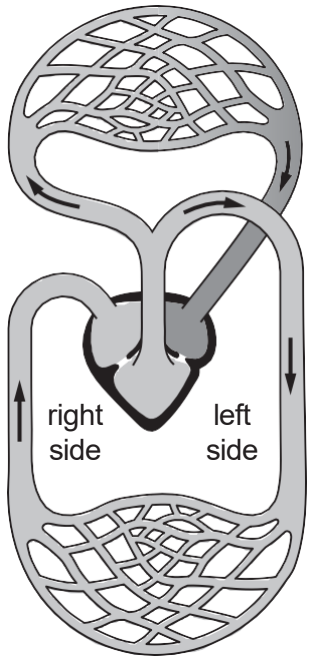
**(a)** The mammalian circulatory system is described as a closed double circulatory system.

**(i)** Explain what is meant by a closed circulatory system.

Blood is always contained within blood vessels

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

**(ii)** The diagram below shows the circulatory system of a frog.




Blood leaving the heart of a frog is less oxygenated than blood leaving the heart of a mammal.

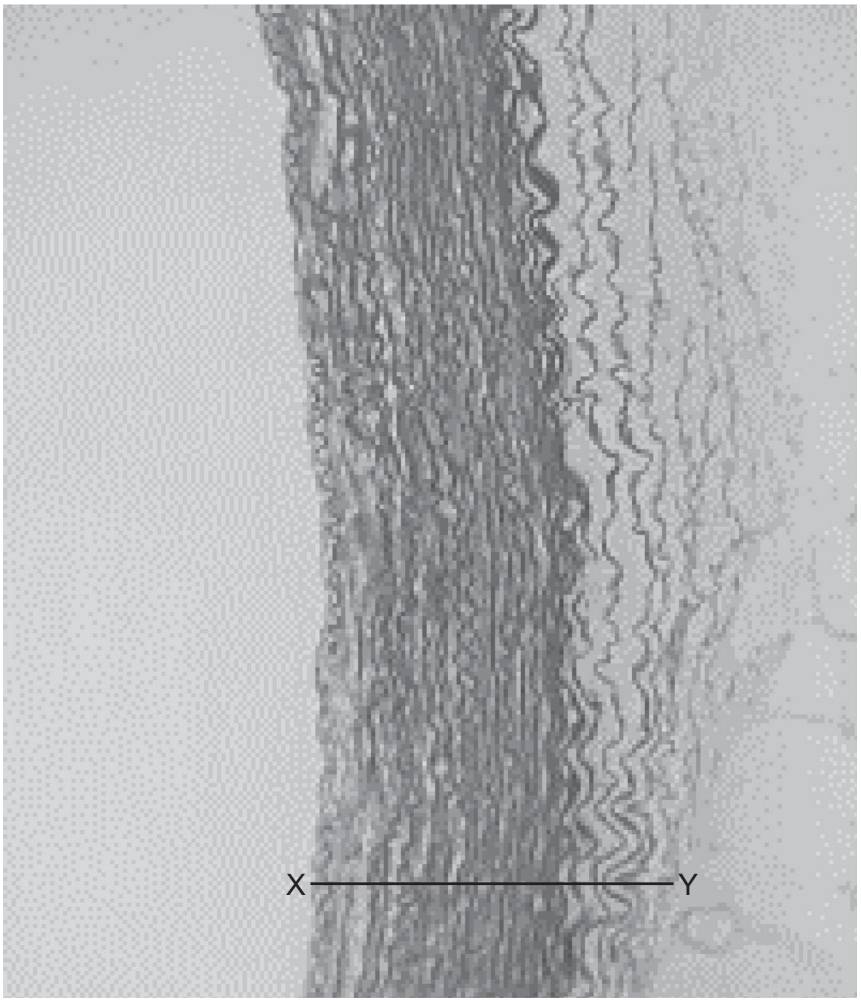
Explain why blood leaving the heart of a frog is less oxygenated than blood leaving the heart of a mammal.

ventricles are not seperated

$CO_2$ can be carried to the muscles

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

**(b)** The image below shows a section through the wall of an artery.




×500

Calculate the actual width of the artery wall between points X and Y.

Give your answer to the nearest whole number.

47mm

Actual width = $\frac{47}{500} \times 100 = 94\mu m$

Actual width = 94 µm **[2]**

**(c)*** Describe how the tissues in the artery wall are adapted to their function.

⇒ Inner Layer
- contains squamous cells
- Smooth
- reduces friction
- Narrow

⇒ Middle layer
- contains Smooth muscle
- involuntary control
- contracts to reduce lumen size
- Maintains blood pressure

⇒ Outer Layer
- large amount of collagen.
- protect from external damage
- elastic fibers allow recoil.
- Prevents rupturing of artery **[6]**

Extra answer space if required.

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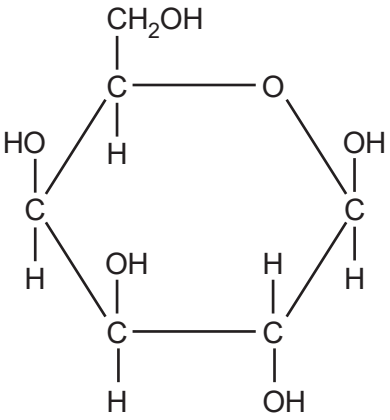
**2**

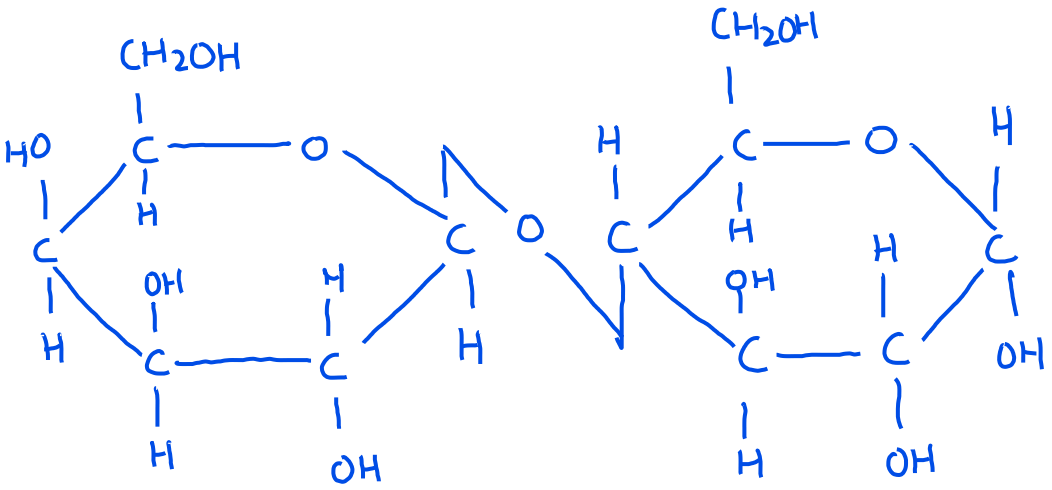
**(a)** Lactose is a disaccharide found in milk.

Galactose is one of the monosaccharides that form lactose.

The structure of galactose is shown below.




**(i)** Draw a molecule of lactose using the galactose molecule above.




**[2]**

**(ii)** During digestion lactose is broken down into monosaccharides.

Name the reaction involved in digestion.

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

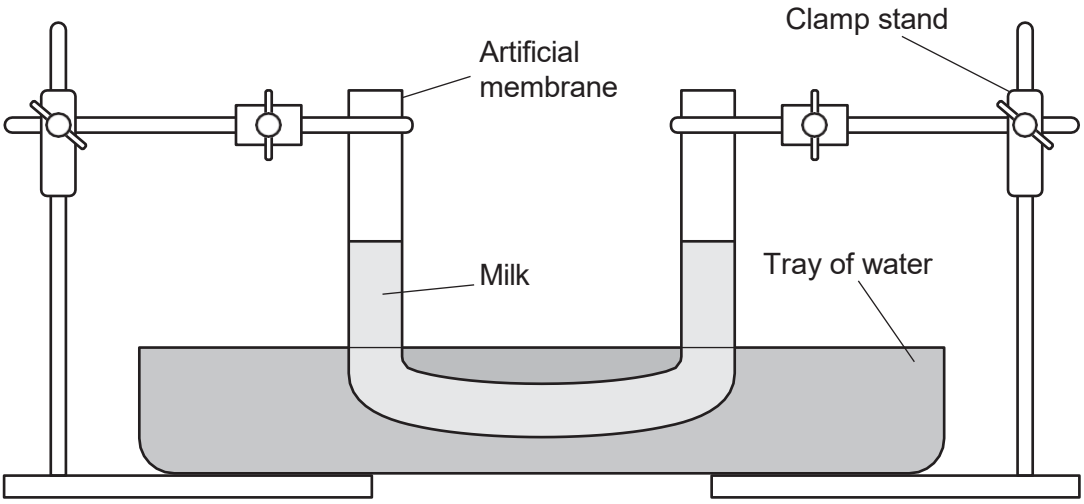
**(b)** A food scientist does an experiment to investigate the effects of different types of milk on a model intestine.

An artificial selectively permeable membrane is used to model the intestine.

This is the method that they use:

- add 25 $cm^3$ of soya milk to a 30 cm long tube of artificial membrane
- attach the membrane between two clamp stands
- place the artificial membrane into a tray of water for 2 hours
- pour the milk out of the artificial membrane into a measuring cylinder and record the volume
- repeat the procedure using other types of milk.

The diagram shows the equipment used in the investigation.




**(i)** Suggest a source of random error in the method.

Volume of milk left in the tubing ..... **[1]**

**(ii)** Explain how the method can be modified to reduce the effect of random error.

repeat with the same type of milk .....

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

The table shows the data from the investigation.

| Type of milk | Volume of milk at 0 hours ($cm^3$) | Volume of milk at 2 hours ($cm^3$) | Percentage change in volume (%) |
|---|---|---|---|
| Soya | 25.0 | 25.4 | 1.6 |
| Skimmed | 25.0 | 26.6 | 6.4 |
| Semi-skimmed | 25.0 | 26.1 | 4.4 |
| Whole | 25.0 | 25.9 | 3.6 |
| Condensed | 25.0 | 31.2 | 24.8 |

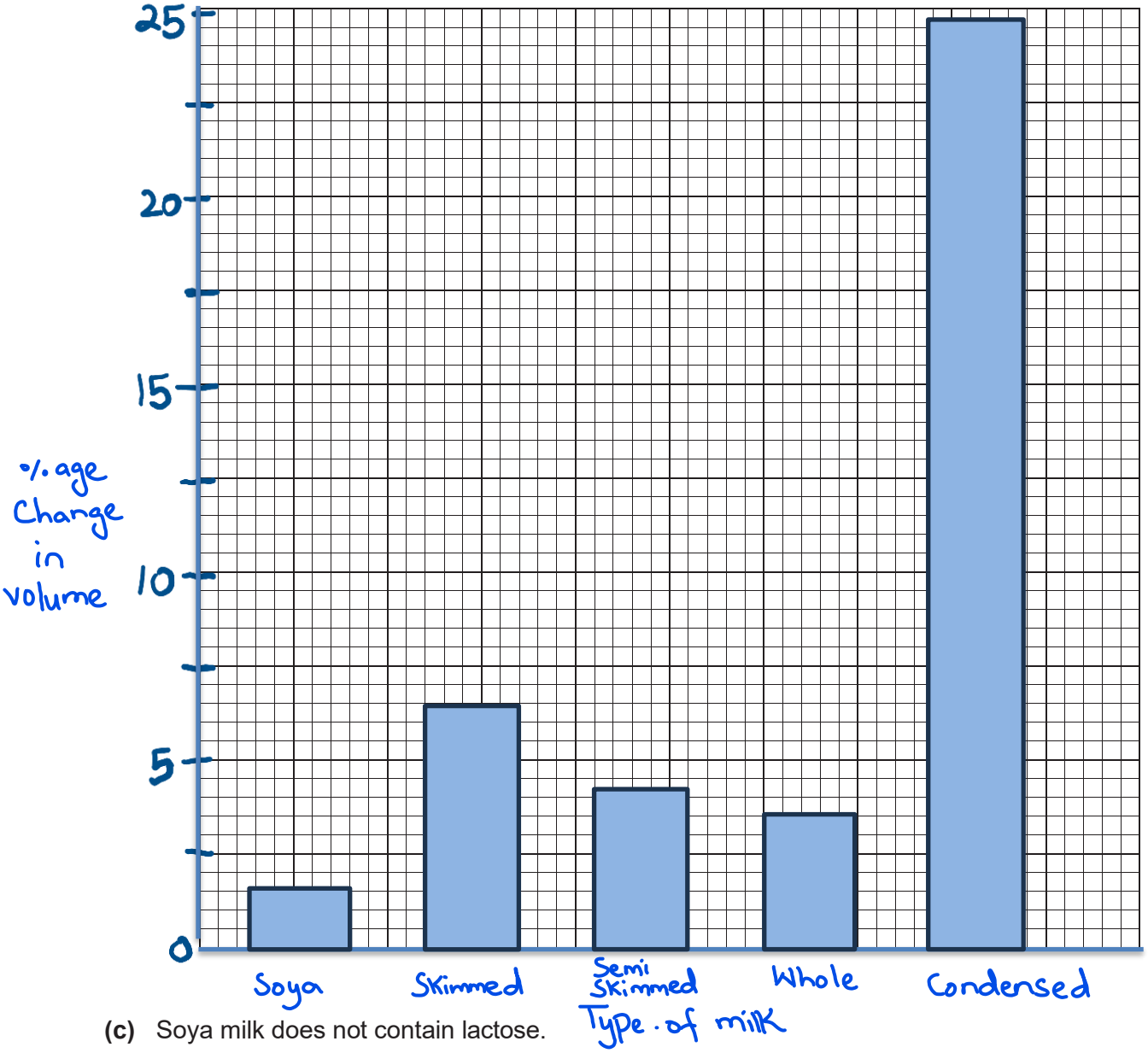
**(iii)** Calculate the percentage change in volume for condensed milk.

$= 31.2 - 25 = 6.2$

$\%age\ Change = \frac{6.2}{25} \times 100 = 24.8$

Percentage change = 24.8 **[2]**

**(iv)** Plot these data using an appropriate format on the grid below.




**[4]**

**(c)** Soya milk does not contain lactose.

Suggest why the soya milk increased in volume.

Soya milk contains Protein which reduces water potential of the milk

**[1]**

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**3**

**(a)** Cancer can be treated using a number of different methods.

Complete the table to show the method of treating cancer and a description of the method.

| Method of treating cancer | Description of method |
|---|---|
| **Surgery** | Removal of a tumour from a localised area |
| Chemotherapy | Cytotoxic drugs that are taken orally or by injection but can weaken the immune system |
| **Hormone-related treatment** | Drugs that are taken orally or by injection to reduce the level of some hormones in the body |
| complementary therapy | Does not directly treat the cancer but can reduce the side effects from other treatments |
| **Radiotherapy** | Uses high energy x-rays to shrink tumours |

**[4]**

**(b)** Imatinib is a cytotoxic drug used to treat cancer.

Scientists took 30 mice that had been genetically modified to produce tumours.
15 mice were given 150 mg $kg^{-1}$ of imatinib twice per day for 18 days.
15 mice were given a placebo twice per day for 18 days.

The graph shows the data from the investigation.

Adapted from ar.iiarjournals.org/content/anticanres/26/2A/1247.full.pdf. Item removed due to third party copyright restrictions.

**(i)** State why the scientists used a placebo in this investigation.

To show that imatinib reduces tumour size.

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

**(ii)** State what conclusions can be made from the data in this investigation.

⇒ Placebo

1- does not reduce the tumour size.

2- Tumour doubles in size every 9 days.

⇒ Imatinib

3- has not affect tumour size in the first 6 days.

4- imatinib shrinks cancer but does not cure it.

**[4]**

**(iii)** The mean mass of the mice was 25 g.

Calculate the mass of imatinib that the scientists used in the investigation.

Include units in your answer.

$\frac{300}{1000} \times 375 \times 18$

Mass of imatinib = 2025 Units = mg **[3]**

**(iv)** The scientists used genetic modification to produce tumours in the mice.

Suggest **one** reason for **and one** reason against using genetic modification to produce tumours in mice.

For Prevents suffering caused by chemicals

Against unethical to produce tumours in mice for use in tests

**[2]**

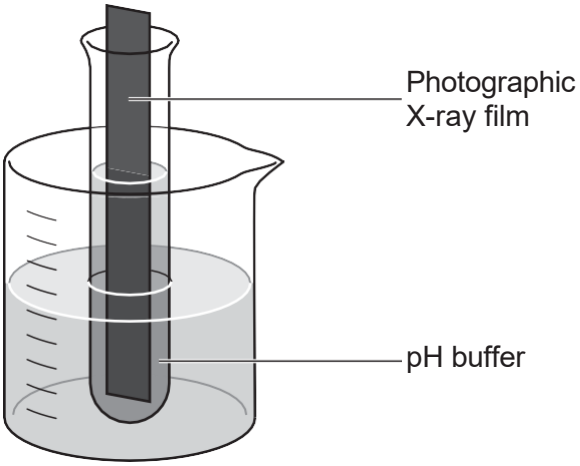
**4**

**(a)** Some students do an experiment to find out how the activity of trypsin (a protease enzyme) varies at different pH and different temperatures.

This is the method that they use:

- place pH 4 buffer solution containing trypsin into a test tube
- place the test tube containing buffer solution into a water bath at 35 °C for 10 minutes
- place a strip of photographic X-ray film into the buffer and start a stop clock
- check the photographic X-ray film regularly by lifting it out of the test tube
- time how long it takes for the photographic X-ray film to turn clear
- repeat the experiment using a range of pH from 4 to 12
- repeat the experiment at 50 °C.

The diagram below shows the equipment used in the investigation.




Photographic X-ray film is made by attaching black photosensitive crystals to a clear sheet of plastic using a protein called gelatin. When gelatin is digested the crystals fall off the black plastic sheet and the sheet turns clear.

**(i)** Explain why the students waited 10 minutes to add the photographic film to the test tube.

allow the trypsin to equilibrate

**[1]**

**(ii)** Give **two** reasons why the students' results may not be valid.

1 The film was only checked periodically

2 may not be the enzyme that causes crystals to fall off.

**[2]**

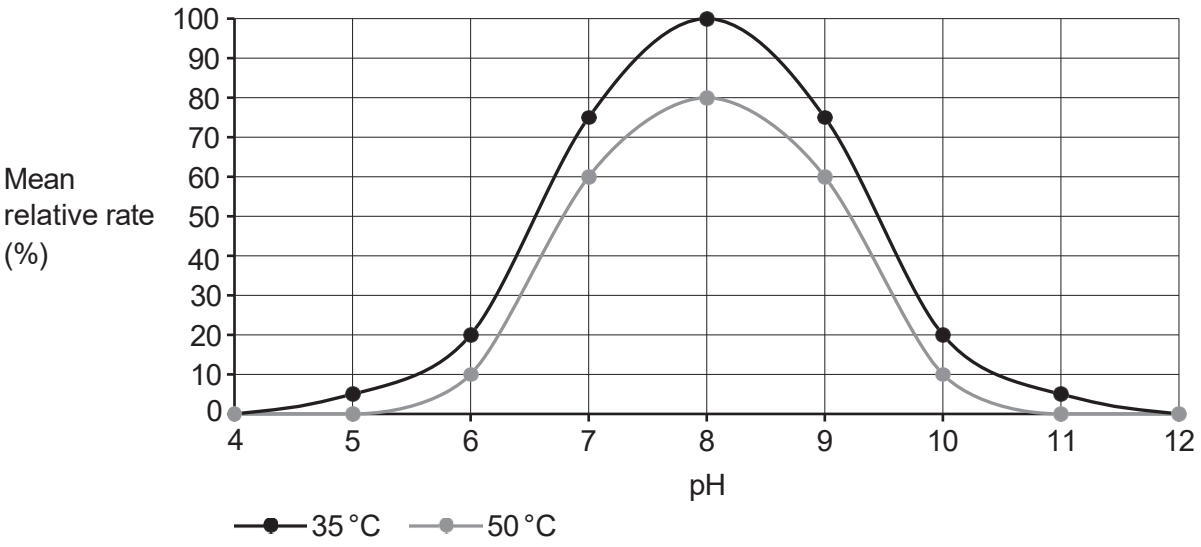
**(b)** Explain why trypsin can digest the gelatin protein in the photographic X-ray film but cannot digest other protease molecules.

Shape of protease active site is not complementary to the shape of other protease molecules.

**[1]**

**(c)** The students calculated the mean relative rate of enzyme activity.

The graph shows the data from the investigation.




**(i)** Explain how the students calculated the relative rate of enzyme activity in this investigation.

time how long it takes for the film to turn clear at every pH.
divide the fastest time by the time take at each pH.

**[2]**

**(ii)** State **two** conclusions that can be made from the data in the graph.

Both have a peak relative rate at pH8
35°C has a higher relative rate of reaction.
both active over a range of pH
50°C has a narrower pH range

**[2]**

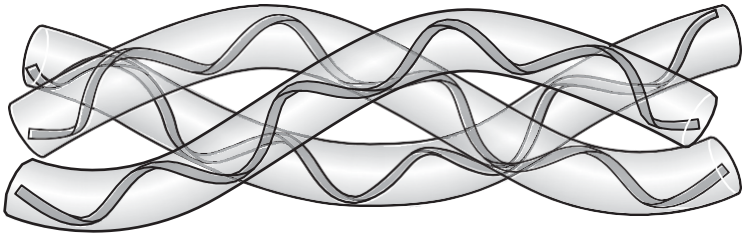
**(iii)** State **two** explanations for the differences in the results for trypsin activity at 35 °C and 50 °C.

- 35°C is closer to the optimum temperature of trypsin.
- 50°C makes the hydrogen bonds break at lower pH.
- Active site no longer complementary to substrate

**[2]**

**(d)*** Gelatin is produced from the breakdown of collagen, a structural protein found in bones and cartilage.

The image below shows part of a molecule of collagen.




Using your knowledge of proteins and enzymes, compare the protein collagen with the enzyme trypsin.

⇒ Similarities of Trypsin and Gelatin:-

- composed of amino acids
- Joined by peptide bonds
- primary and secondary Structure
- Hydrogen bonds
- pleated Sheet

⇒ Differences

- Trypsin is soluble while gelatin is insoluble
- Trypsin is Spherical while gelatin is linear.
- Trypsin is folded While gelatin is unfolded.
- Trypsin has metabolic function while gelatin has Structural function **[6]**

Extra answer space if required.

.....

.....

.....

.....

.....

**5**

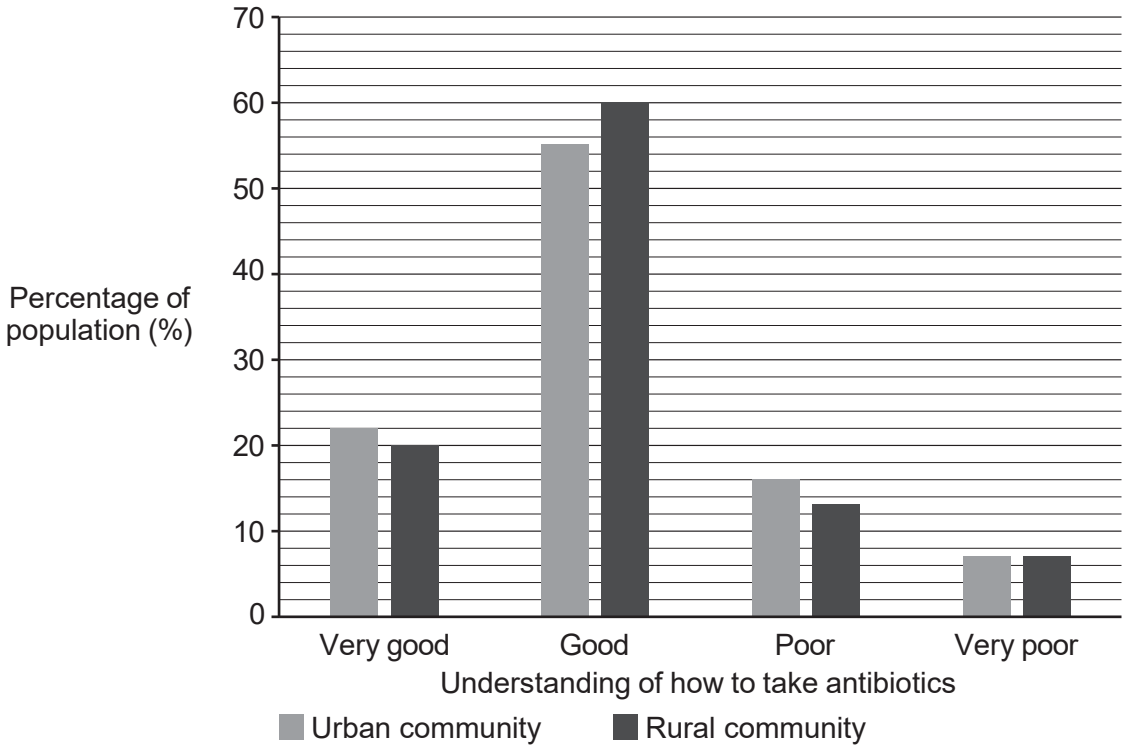
**(a)** Tuberculosis (TB) is caused by the bacterium *Mycobacterium tuberculosis*.

There are different strains of TB.

Educating people on the correct use of antibiotics has been a major focus in reducing the development of a strain of TB called multi-drug resistant tuberculosis (MDR-TB).

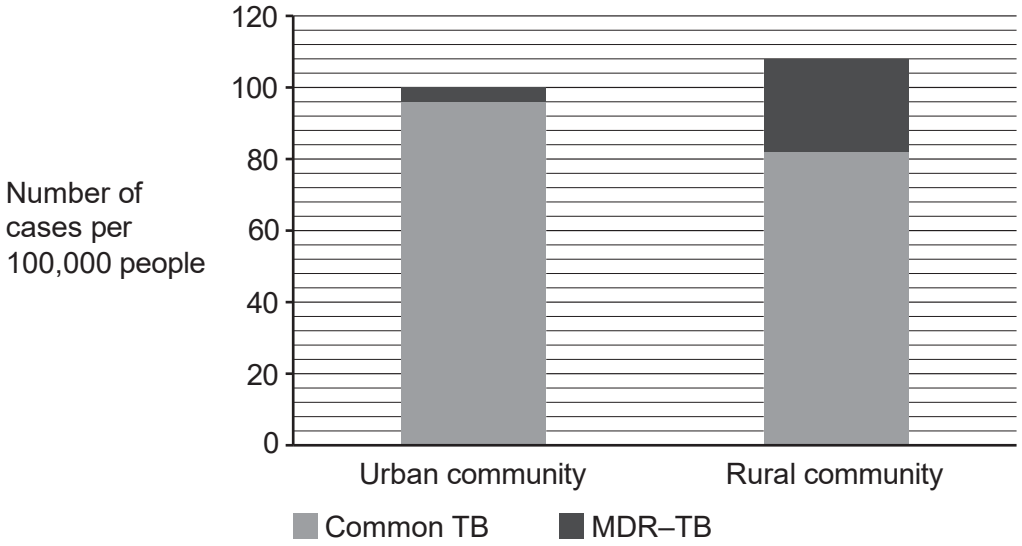
In a region where TB is endemic, two communities completed a survey asking them how well they understood how to take antibiotics correctly. The results of the survey are shown in **Fig. 5.1**.

**Fig. 5.1**




The strain and prevalence of TB cases in the urban and rural communities is shown in **Fig. 5.2**.

**Fig. 5.2**



**(i)** The following conclusions were drawn from the data in **Figs. 5.1** and **5.2**.

- Urban communities have a better understanding of antibiotic use.
- There is less risk of getting TB in a rural community.

Evaluate these conclusions.

⇒ Supporting arguments :-

- more of the urban community has a very good understanding.
- fewer cases of common TB in the rural community.

Arguments against :-

- more of the urban community has a very poor understanding
- The total risk from all strains of TB is higher in the rural community. **[4]**

**(ii)** Outline how a population of *M. tuberculosis* may become multi-drug resistant.

- Random mutations occur in population.
- antibiotics are the selection pressure
- resistant bacteria survive and multiply.
- Advantageous allele passed on. **[3]**

**(b)** Capreomycin is an antibiotic that can be used to treat TB.

Capreomycin inhibits protein synthesis in *M. tuberculosis*.

**(i)** Explain why capreomycin is safe for human use.

Ribosomes are different sizes antibiotics only bind to bacterial ribosomes

**[2]**

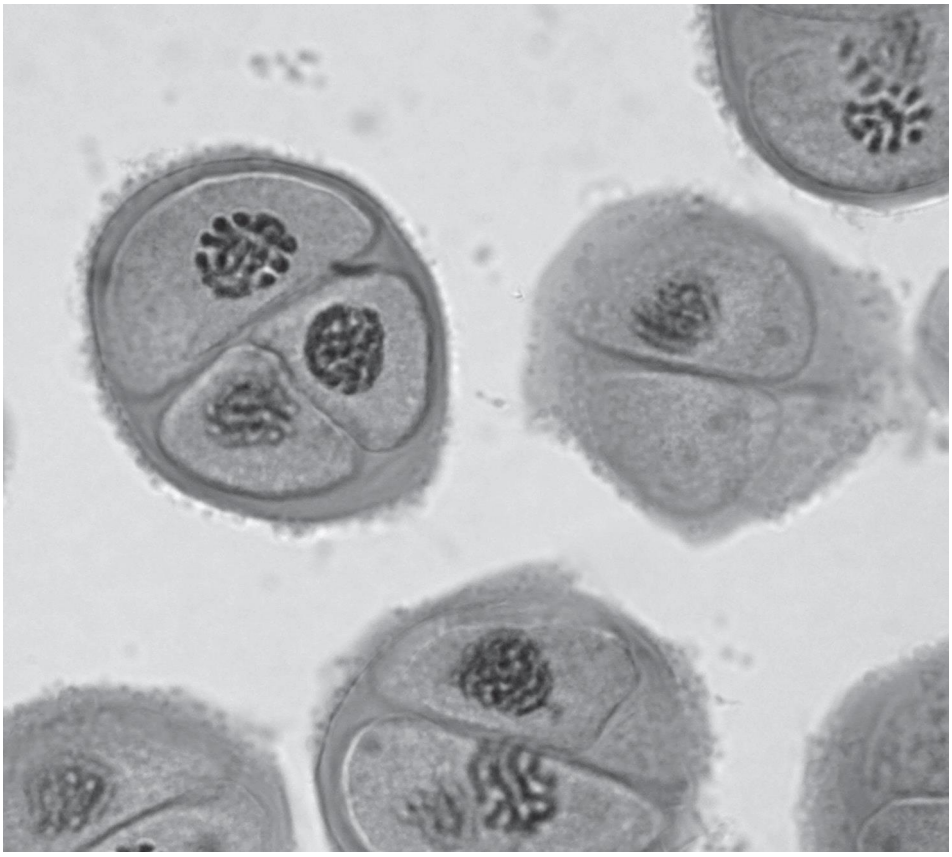
**(ii)** Suggest why capreomycin may cause some side effects despite being safe for human use.

Kills other bacteria Causes allergic reaction

**[1]**

**6**

**(a)** The image shows pollen grains in various stages of meiosis.



**(i)** State the type of microscope used to produce this image.

Give a reason for your answer.

Type ..... light microscope .....

Reason ..... low resolution .....

.....

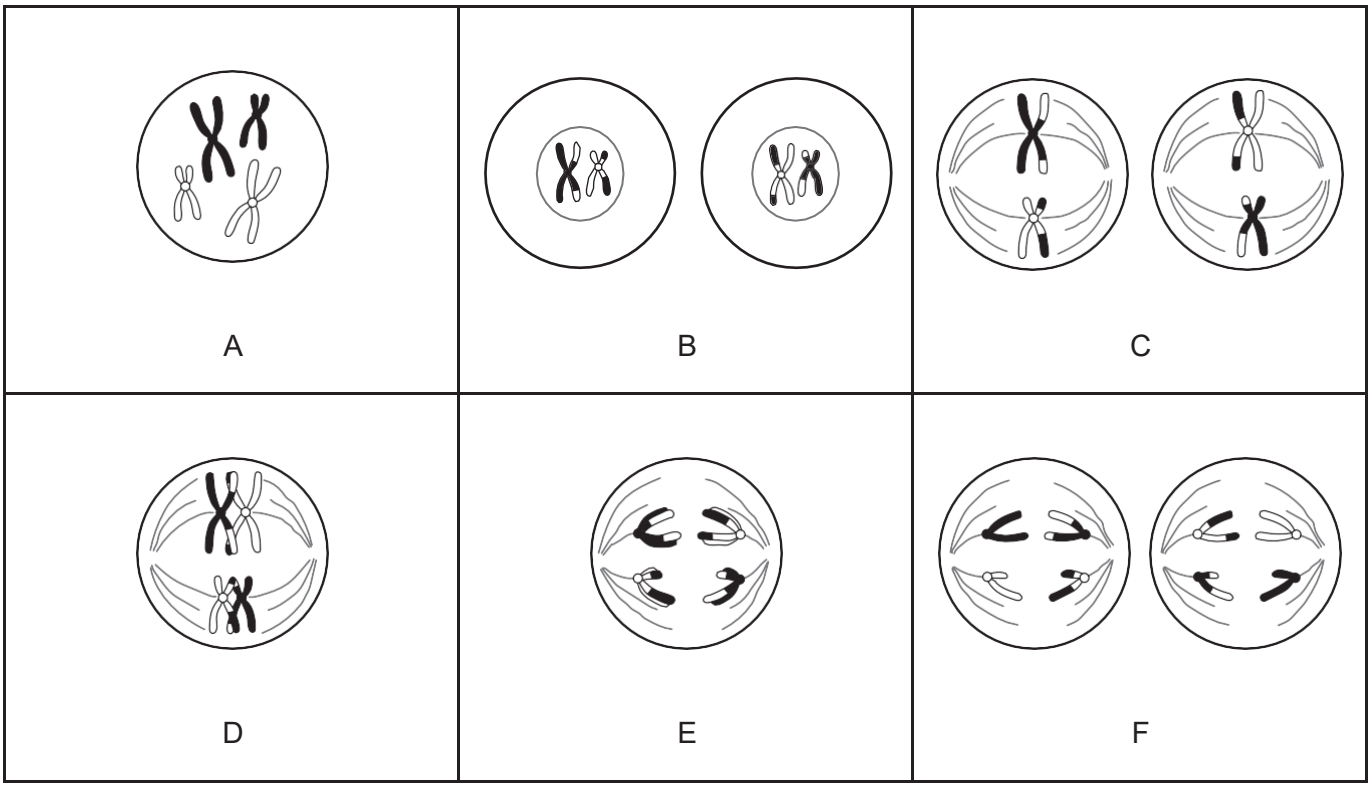
**[2]**

**(ii)** Using the image, state how meiosis in plants differs from meiosis in animals.

..... cells do not seperate at the end of .....

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

**(b)** The image below shows some stages of meiosis in an animal.




Write the letters in the boxes to show the stage being described in each of the following statements.

Separation of sister chromatids [F]

Formation of haploid cells [B]

Independent assortment of chromosomes [D]

Crossing over is occurring [D]

**[4]**

**END OF QUESTION PAPER**

## EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.