Please check the examination details below before entering your candidate information

| Candidate surname | Other names |
|---|---|
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**Pearson Edexcel**
**International Advanced Level**

Centre Number | Candidate Number

**Time** 1 hour 30 minutes

**Paper reference** **WBI12/01**

# Biology

## International Advanced Subsidiary/Advanced Level UNIT 2: Cells, Development, Biodiversity and Conservation

**You must have:**
Scientific calculator, ruler, HB pencil

Total Marks

## Instructions

- Use **black** ink or **black** ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- **Show all your working in calculations and include units where appropriate.**

## Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

## Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- Good luck with your examination.

*Turn over* ▶

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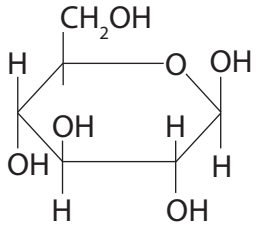
Pearson

**Answer ALL questions.**

**Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.**

**1** Plants contain many types of molecule.

(a) (i) Which molecule is shown in the diagram?




**(1)**

☒ **A** $\alpha$-glucose

☒ **B** $\beta$-glucose

☒ **C** starch

☒ **D** sucrose

(ii) Which is a feature of cellulose molecules?

**(1)**

☒ **A** contain peptide bonds

☒ **B** contain $\alpha$-glucose molecules

☒ **C** form microfibrils

☒ **D** are soluble

(iii) Which molecule contains magnesium ions?

**(1)**

☒ **A** calcium pectate

☒ **B** chlorophyll

☒ **C** DNA

☒ **D** starch

(b) Plants contain tissues that have different functions.

(i) Name **one** tissue that gives the plant support and is also involved in the transport of water through the plant.

**(1)**

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(ii) Name **one** fibre that gives the plant support but is **not** involved in the transport of water through the plant.

**(1)**

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**(Total for Question 1 = 5 marks)**

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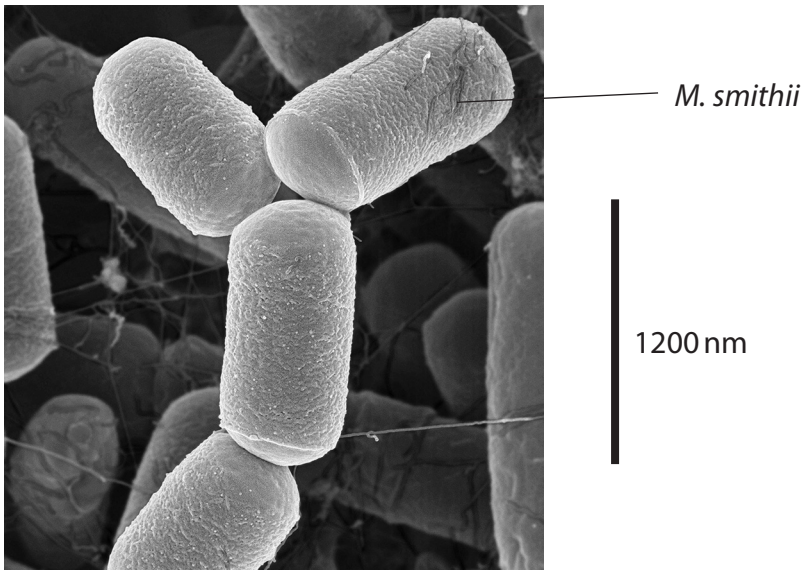
**2** *Methanobrevibacter smithii* (*M. smithii*) is a single-celled microorganism found in the human intestine.

The photograph shows *M. smithii*.




(© DENNIS KUNKEL MICROSCOPY / SCIENCE PHOTO LIBRARY)

(a) (i) Calculate the magnification of this photograph.

Give your answer in standard form to two significant figures.

**(2)**

Answer .....

(ii) Explain which type of microscope was used to take this photograph.

**(2)**

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(b) Scientists classified this microorganism as a species in the domain Archaea.

(i) Describe the information the scientists would have used to classify *M. smithii* into the Archaea domain.

**(2)**

(ii) Scientists have identified a similar microorganism in the human mouth.

This microorganism is called *Methanobrevibacter oralis* (*M. oralis*).

Explain how the scientists could confirm that *M. smithii* and *M. oralis* are different species of Archaea.

**(3)**

**(Total for Question 2 = 9 marks)**

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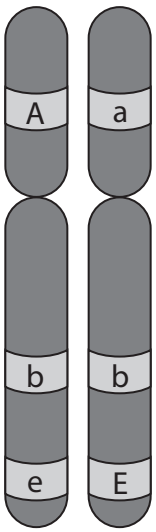
**3** The nucleus of a cell contains chromosomes.

The diagram shows three genes present on a pair of chromosomes.




(a) (i) How many of the following statements about this diagram are correct?

- there are three gene loci
- the pair of chromosomes will be separated into different cells following mitosis
- one chromosome was inherited from the mother and one chromosome was inherited from the father

**(1)**

☒ **A** none

☒ **B** one

☒ **C** two

☒ **D** three

(ii) Describe what will happen to these chromosomes when they enter the interphase stage of the cell cycle.

**(2)**

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(b) Crossing over between pairs of chromosomes increases genetic variation.

(i) Name the stage of meiosis in which crossing over begins.

**(1)**

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(ii) How many of the following combinations could result from one crossover of the chromosomes shown in the diagram?

- AbE
- ABe
- abE
- abe

**(1)**

☒ **A** one

☒ **B** two

☒ **C** three

☒ **D** four

(iii) Explain why alleles b and e are more likely to be inherited together than alleles A and e.

**(2)**

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

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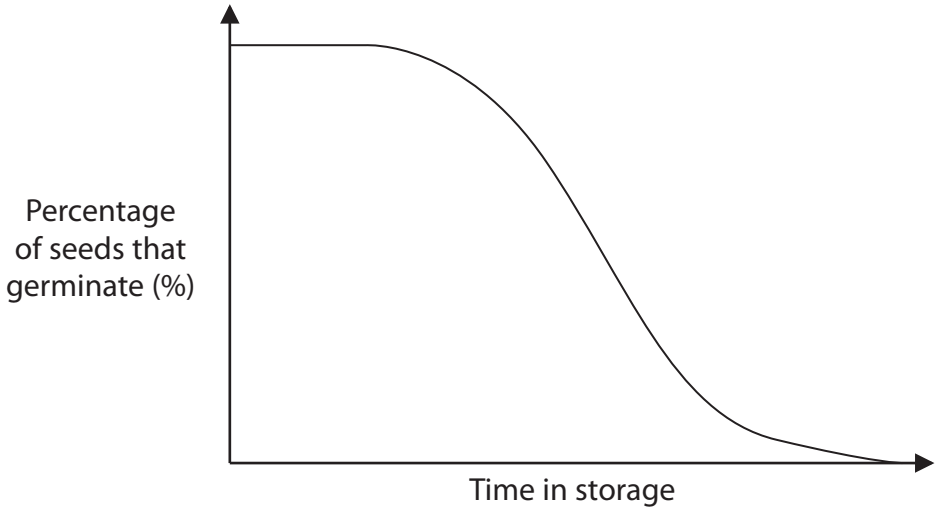
**4** Seed banks are used to store seeds from a wide variety of plants. Some plants are a sustainable source of bioplastics.

(a) The Germplasm Bank of Wild Species is the largest seed bank for wild species of plants in Asia.

Seeds from 8 500 species have been collected and stored.

Seeds were dried before being stored at temperatures below 0 °C.

The effect of length of time in storage on seed germination is shown in the graph.




(i) Describe the effect of length of time in storage on the germination of these seeds.

**(2)**

(ii) Two of the methods used in seed banks are:

- store seeds from many different plants of the same species, instead of many seeds from just one plant
- regularly germinate samples of the stored seeds, allowing them to grow into adult plants.

Explain the advantages of these methods.

**(4)**

(b) The photograph shows bioplastic straws and cutlery, produced from the seeds of avocados.

© Facinadora / Alamy Stock Photo

(i) In 2018, a company in Mexico produced 130 000 kg of bioplastic cutlery and straws per month.

40% of the products were straws.

Calculate the mass of cutlery produced per year by this company.

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

**(2)**

Answer .....

(ii) The use of these plant-based products is more sustainable than the use of cutlery and straws made from oil-based plastic.

Explain what is meant by the term sustainable, with reference to the cutlery produced from the seeds of avocados.

**(2)**

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**(Total for Question 4 = 10 marks)**

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**5** The number and size of Golgi apparatus vary depending on the type of cell.

(a) (i) Draw a labelled diagram of the Golgi apparatus.

**(4)**

(ii) How many of the following are functions of the Golgi apparatus?

- formation of extracellular enzymes
- modification of proteins
- formation of peptide bonds through condensation reactions

**(1)**

☒ **A** none

☒ **B** one

☒ **C** two

☒ **D** three

(iii) A cell was supplied with radioactive amino acids. The cell took in these amino acids and used them in protein synthesis.

Which structure in the cell would become radioactive first?

**(1)**

☒ **A** centrioles

☒ **B** Golgi apparatus

☒ **C** lysosomes

☒ **D** ribosomes

(b) In a mammalian cell, there was one Golgi apparatus with a diameter of 1.1 μm.

In a maize cell, there were 600 Golgi apparatus. The largest diameter of Golgi apparatus in the maize cell was 0.5 μm.

(i) Calculate the percentage difference in these diameters.

**(1)**

Answer .....%

(ii) The number and size of the Golgi apparatus in the maize cell increases during one stage of the cell cycle.

In which stage of the cell cycle would the number and size of the Golgi apparatus increase?

**(1)**

☒ **A** anaphase

☒ **B** interphase

☒ **C** prophase

☒ **D** telophase

(iii) Suggest why the number and size of the Golgi apparatus change during the cell cycle.

**(4)**

**(Total for Question 5 = 12 marks)**

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**6** Many female organisms produce egg cells containing cortical granules.

(a) Explain how cortical granules ensure that the egg cell is diploid after fertilisation.

**(4)**

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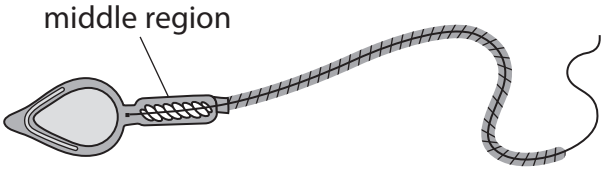
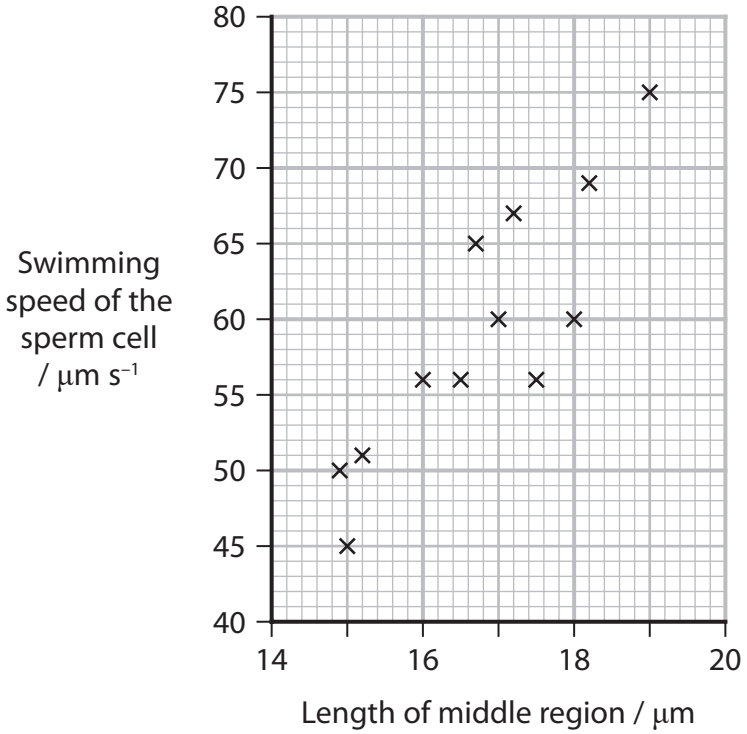
*(b) Organisms have evolved different mating strategies such as:

- Some male animals have sperm cells with longer middle regions, as shown in the diagram.




The females of these species produce multiple egg cells and mate with many males in a short period of time.

The graph shows the effect of the length of the middle region on the swimming speed of the sperm cell.




- Some male animals, such as the zebra longwing butterfly, produce spermatophores that remain inside the reproductive system of the female after mating.

  The spermatophore contains sperm cells and nutrients for the female. The spermatophore also releases chemicals that reduce the attractiveness of this female butterfly to other males.

- Some female animals, such as the eastern box turtle, mate with numerous males and then store the sperm for a number of years. This allows fertilised egg cells to be laid even when the female has not mated in that year.

Comment on the effect that these three mating strategies would have on the reproductive success of the males and females, and the genetic diversity of the offspring.

**(6)**

**(Total for Question 6 = 10 marks)**

**7** The Galapagos Islands are located off the west coast of South America.

The biodiversity on these islands has changed over the past 40 years due to human activity.

One of these islands is called Santa Cruz.

(a) The population of Santa Cruz increases by approximately 6.4% per year.

The majority of the population, 85%, live in urban areas.

The population of Santa Cruz living in urban areas in 2020 was 17 000.

Predict the total population of Santa Cruz in 2025.

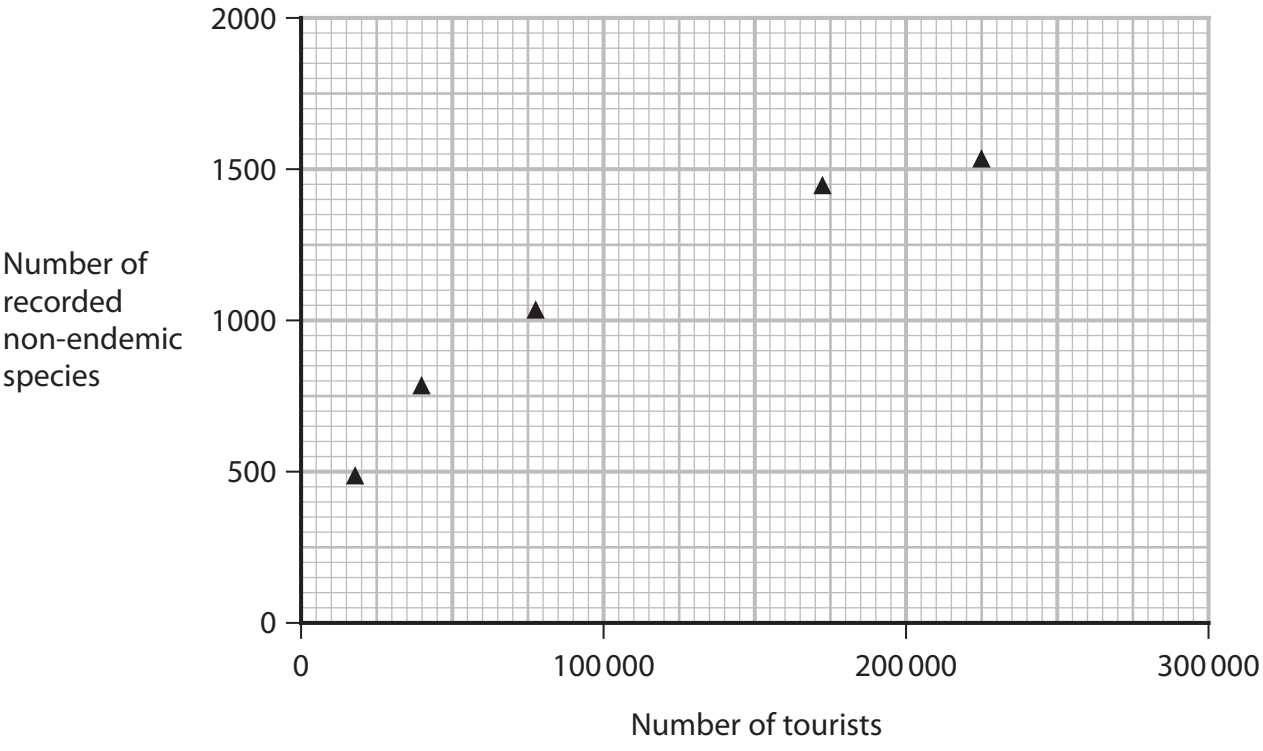
Assume that the rate of increase stays constant.

**(3)**

Answer .....

(b) Non-endemic species have been introduced to the Galapagos Islands.

The graph shows the number of tourists to all the islands and the number of recorded non-endemic species.




https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0184379

State the relationship shown in the graph.

**(1)**

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(c) The wild blackberry was introduced to Santa Cruz in 1970 and has since spread over much of the island.

This has resulted in the reduction of the native endemic forest.

In 1960, the number of species in an area of the native forest was measured.

The table shows these results.

| Species | Number of individuals (n) | (n – 1) | n(n – 1) |
|---|---|---|---|
| A | 21 | 20 | |
| B | 2 | 1 | 2 |
| C | 4 | 3 | 12 |
| D | 13 | 12 | |
| E | 54 | 53 | |
| F | 15 | 14 | 210 |
| G | 6 | 5 | 30 |
| H | 32 | 31 | |
| | Total (N) = | | Σn(n – 1) = |

(i) Calculate the index of diversity (D) for this area of the forest using the formula

$$D = \frac{N(N-1)}{\Sigma n(n-1)}$$

Use the table to help you.
Give your answer to **one** decimal place.

**(3)**

Answer .....

(ii) Explain why the spread of the wild blackberry affects the biodiversity of the island.

**(5)**

**(Total for Question 7 = 12 marks)**

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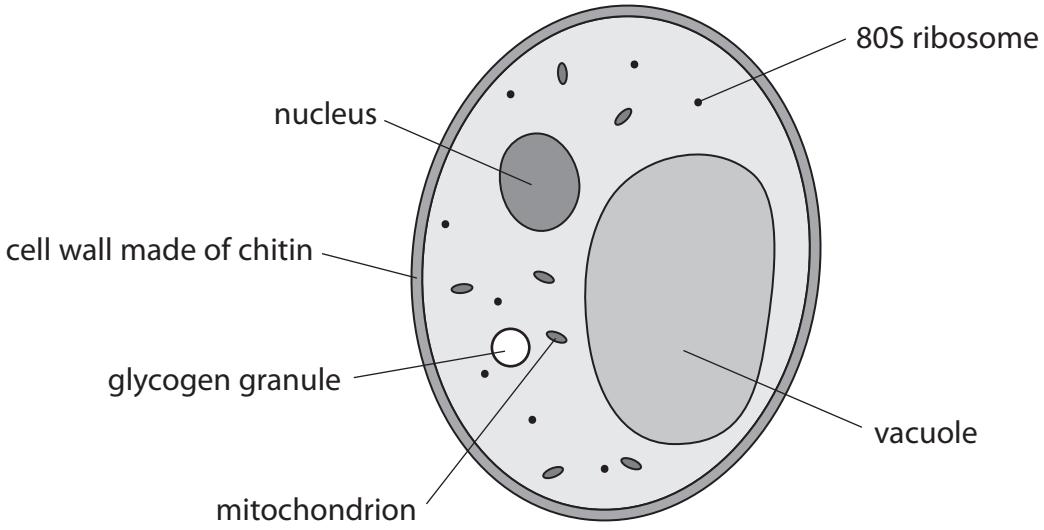
**8** Some fungi infect plants and affect the expression of the plant genes.

(a) A student drew and labelled a fungal cell.




Compare and contrast the structure of this fungal cell and a plant cell.

**(3)**

(b) The photograph shows darnel, a species of grass.

© blickwinkel / Alamy Stock Photo

The fungus *Epichloë festucae* lives within darnel for part of its life cycle.

The fungus influenced the expression of certain genes in the plant cells.

- There was reduced expression of some genes involved in DNA synthesis.
- There was reduced expression of some genes involved with the synthesis of phospholipids, starch and sucrose.

(i) Explain the effect of this fungal infection on the growth of the plant.

**(4)**

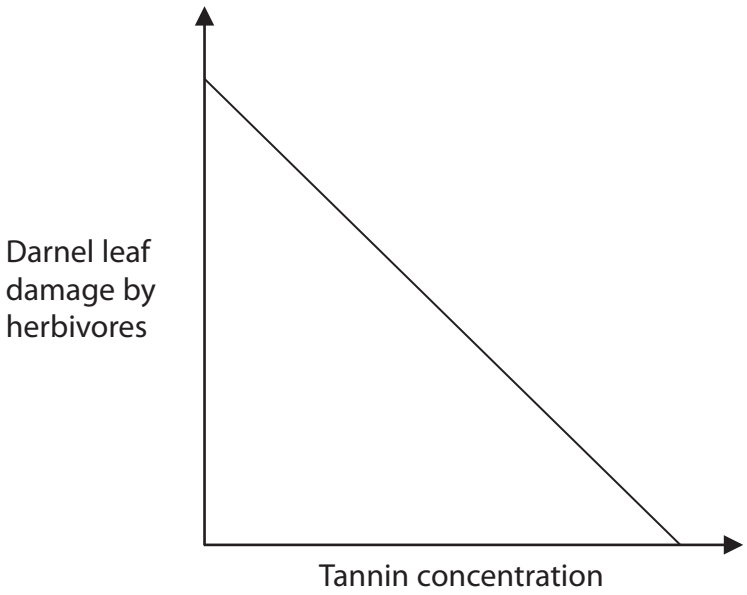
*(ii) The fungus and the plant both benefit from this relationship.

The fungus absorbs nutrients from the plant.

The expression of certain genes in the plant cells is increased when infected with the fungus.

These genes are involved in the synthesis of tannin and flavonoids.

The graph shows the relationship between tannin concentration and the degree of darnel leaf damage by herbivores (grazing animals).




The table shows the antimicrobial effect of different concentrations of flavonoids on cultures of the bacterium *Pseudomonas aeruginosa*. This bacterium causes disease in plants.

| Flavonoid concentration / $\mu g\ cm^{-3}$ | Diameter of inhibition zone / mm |
|---|---|
| 500 | 7.0 |
| 666 | 8.0 |
| 1000 | 9.0 |

The fungus increases the expression of the genes involved in the synthesis of tannin and flavonoids.

Discuss the advantages and disadvantages of this for the fungus and for the infected plants.

**(6)**

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(iii) The bacterium *Pseudomonas aeruginosa* causes lung infections in humans.

Describe how a drug containing flavonoids could be tested in a stage II drug trial.

**(2)**

**(Total for Question 8 = 15 marks)**

**TOTAL FOR PAPER = 80 MARKS**

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