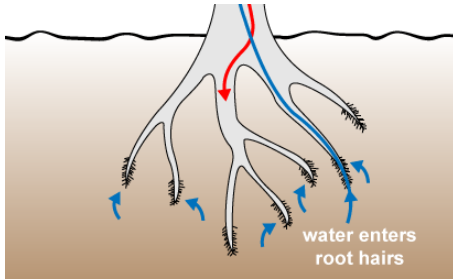


**Question 1** (10 marks)

Living cells and organisms exchange materials with their environment.

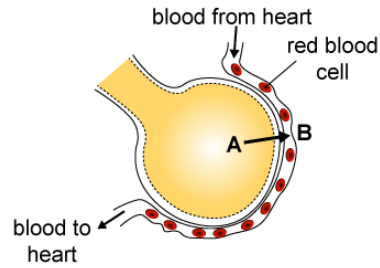
**Question 1a** (2 marks)

**Select** the option describing the transport mechanism in the diagrams below.



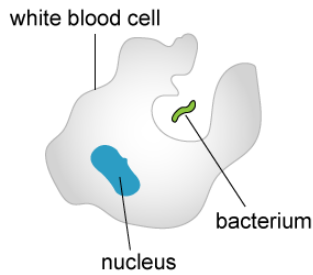
Water is taken up by root hair cells.

Osmosis



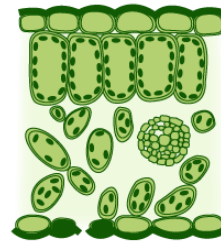
In the lungs oxygen is taken up into the bloodstream.

Diffusion



A white blood cell taking in bacteria.

Neither



Oxygen is given out by the leaf cells.

Neither

**Question 1b** (1 mark)

Oxygen is carried by red blood cells. **State** the name of the organ system which carries blood through the human body.

**Question 1c** (2 marks)

Using scientific terms, **outline** why the uptake of oxygen from the lungs into the bloodstream does not require energy.

**Question 1d** (1 mark)

---

Besides oxygen, the blood in the circulatory system also carries messenger substances called hormones. **State** the name of another system that transmits signals in the human body.

**Question 1e** (4 marks)

---

**Select** one of the senses.

- sight
- hearing
- taste
- smell
- touch

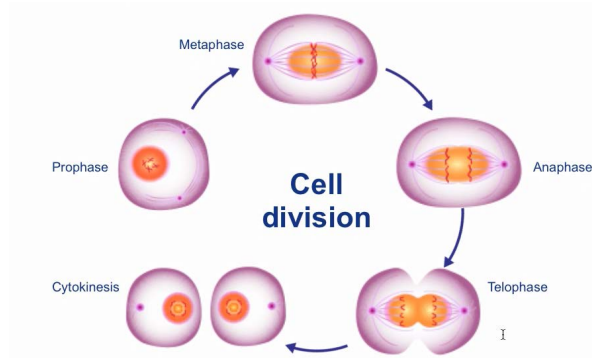
**Explain** how this sense and the transmission of signals inside the human body leads to responses which help us to survive. You should refer to an example of a survival situation in your answer.

**Question 2** (12 marks)

**Question 2a** (1 mark)

**State** the name of the molecule that stores genetic information in living organisms.

The following diagram shows the phases of mitosis.



**Question 2b** (3 marks)

**Outline** how the events in anaphase are crucial for the formation of two identical cells.

**Question 2c** (3 marks)

Mitosis is the process that leads to growth and repair whereas meiosis is required for sexual reproduction.

**Outline three** differences between the products of mitosis and meiosis.

**Question 2d** (2 marks)

**Describe one** problem that can occur to the genetic molecule during meiosis.

**Question 2e** (3 marks)

**Explain** how **one** process that occurs in meiosis can lead to genetic differences in children.

**Question 3** (7 marks)

Identical twins have the same genes so they are genetically identical.

**Question 3a** (1 mark)

Select one pair of twins.



Pair 1 ●



Pair 2 ●



Pair 3 ●

Identify a feature in which this pair of twins differ.

Pair 1: Martin Schoeller/ AUGUST  
Pair 2: University Hospitals Case Medical Center, www.healthyandhandsome.nl  
Pair 3: © Tommy Kono

The twins in the images are genetically identical.

**Question 3b** (1 mark)

Suggest a factor which could account for the difference in the feature you identified in part (a).

**Question 3c** (2 marks)

Outline a reason why the difference seen in the twins may not be seen in the children of each twin.

The table shows four people, identified by the letters A, B, C, and D.

Trait	A	B	C	D
Have a sun tan	yes	yes	no	no
Sex	male	male	male	female
Tongue roll	yes	no	yes	no
Natural hair colour	brown	brown	brown	brown
Have coloured or dyed white hair	no	no	yes	yes
Eye colour	brown	brown	brown	blue

Tongue roll:



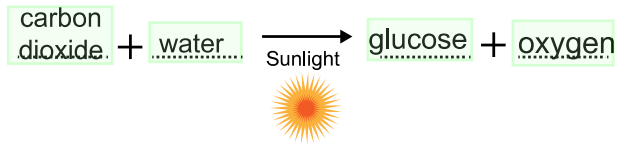
**Question 3d** (3 marks)

Use the information in the table to identify which two people are identical twins. Justify your answer using examples from the table.

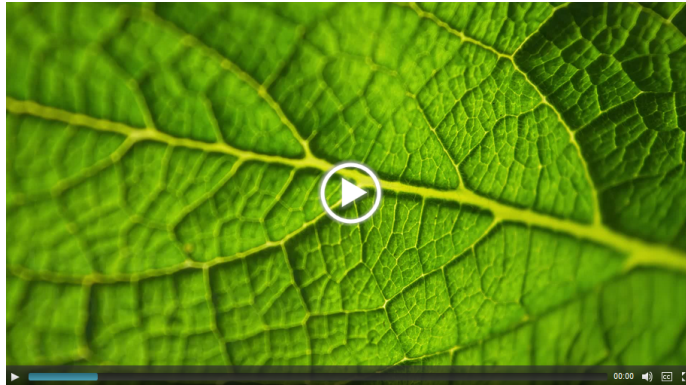
Question 4 (18 marks)

Question 4a (1 mark)

Organize the following molecules into the correct positions to show the word equation for photosynthesis.



In this question you will investigate how the rate of photosynthesis is related to the environmental conditions of a plant.



Question 4b (1 mark)

State the problem being tested by this

Question 4c (4 marks)

Formulate a testable hypothesis for this experiment. Use scientific reasoning to explain your answer.

**Question 4d** (10 marks)

---

**State** the variables and **outline** how to manipulate those stated.

Independent variable

How to manipulate this variable

Dependent variable

How to manipulate this variable

Control variables

How to manipulate these variables

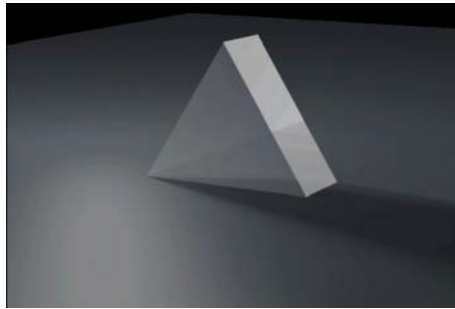
**Question 4e** (2 marks)

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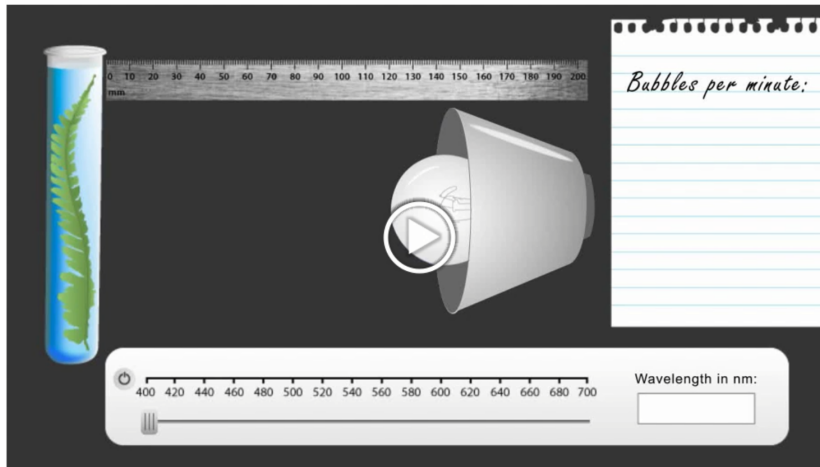
**State** how many trials should be conducted for this experiment in order to collect sufficient data. **Justify** your answer.

**Question 5** (10 marks)

Photosynthesis is a light dependent process. Sunlight is made up of light of different wavelengths. Wavelength is related to the colour of light.



A group of students were interested in testing the effect of wavelength of light on photosynthesis so they designed the apparatus shown below to measure the change in gas production of a plant due to photosynthesis. The animation shows what the experiment looked like.



**Question 5a** (4 marks)

**Suggest a design for a data table to collect a sufficient amount of data from the investigation. You need to state the number of rows and columns and state appropriate labels to your table.**

Number of rows:

Labels for rows:

Number of columns:

Labels for columns:

**Question 5b** (3 marks)

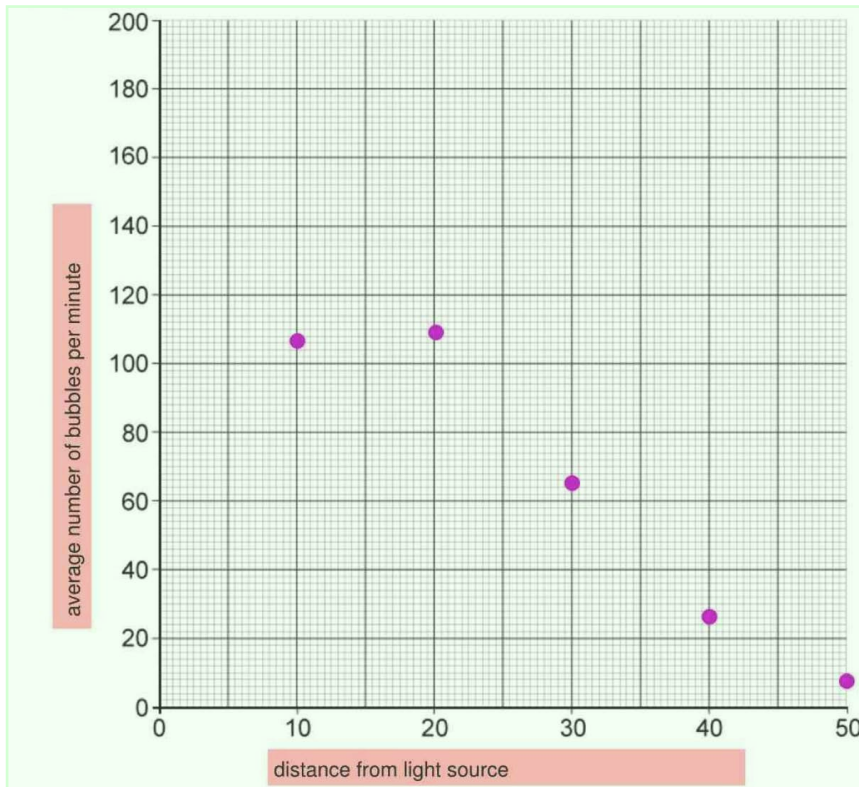
After doing this first experiment the students found that the maximum rate of photosynthesis occurred at a wavelength of 650 nm and they decided to study this further. The students now investigated the effect of distance from the light source on photosynthesis. Their data is presented in the table below. Use the calculator tool to **calculate** the mean average of the data. You should give your values to an appropriate number of significant figures.

Distance from the light source / cm	Bubbles of gas / min				
	Trial number				
	1	2	3	4	5
10	118	89	109	102	119
20	109	99	101	112	119
30	59	63	58	67	70
40	19	24	31	27	33
50	8	15	4	11	8

**Question 5c** (3 marks)

**Present** the transformed data in a graph using the graphing tool. You need to add appropriate labels to the axes and give your graph an appropriate title.

Graph title



Question 6 (14 marks)

Biomass is the mass remaining when all water has been removed from an organism.

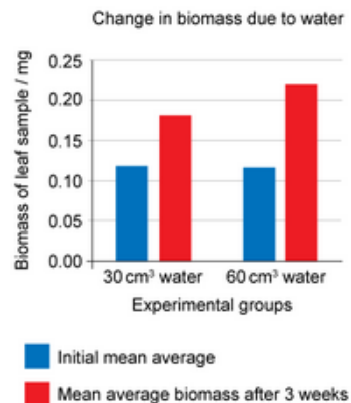
A different group of students wanted to determine how other factors might affect photosynthesis. They found details of the following investigation into biomass.

**Hypothesis:**

If one group of plants receives more water then the biomass of those plants will increase more than the plants with less water added.

**Overview of Method:**

- Step 1: Collect 20 plants of the same species and similar size.
  - Step 2: Pull one leaf from each plant, cut a square 2 cm × 2 cm, dehydrate the square, and then weigh the leaf samples.
  - Step 3: Place all of the plants in an environment with similar soil, light, and temperature.
  - Step 4: Add 30 cm<sup>3</sup> of water to 10 of the plants every other day and add 60 cm<sup>3</sup> of water to the other 10 plants every other day.
  - Step 5: After 3 weeks, remove 1 leaf from each plant and follow step 2.
- The results from the investigation are shown in the graph.



Question 6a (1 mark)

State one trend in the data.

Question 6b (3 marks)

Explain one scientific reason for the difference in final and initial mean average biomass for the two groups.

Question 6c (1 mark)

Comment on the validity of the hypothesis based on the data.

Question 6d (4 marks)

Based on the method and apparatus presented, describe one strength and one weakness related to the method's design.

Question 6e (4 marks)

Outline two improvements to this investigation. Justify your answers.

Question 6f (1 mark)

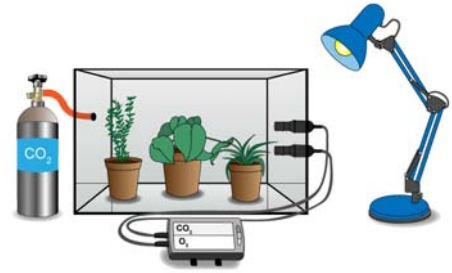
Other than changing the temperature or light, state one extension to this method that would benefit this scientific investigation.

**Question 7** (16 marks)

After the students had completed all of these investigations they wanted to conduct one final investigation. In the back of the science room they found an apparatus that had been donated to the school that looked like the image below.

**Design** an investigation that would use this apparatus to study photosynthesis. Your plan should:

- state a problem to be studied
- formulate and explain a testable hypothesis
- identify relevant variables
- describe how to measure and manipulate the variables
- describe the method
- list any safety considerations.



A large, empty rectangular box with a light green background, intended for the student to write their investigation plan.

**Question 8** (7 marks)

Human activities are leading to the loss of biodiversity in the world's ecosystem. The human activities listed below are the main causes of the loss of biodiversity.



**Alteration and loss of habitats**  
Before: Rich woodland

**Alteration and loss of habitats**  
After: Deforestation

**Introduction of invasive species**  
Before: Native species present

**Introduction of invasive species**  
After: Non-native species colonize the habitat

**Pollution**  
Before: Clean river

**Pollution**  
After: Polluted river

**Overexploitation of resources**  
Before: Healthy fish stocks

**Overexploitation of resources**  
After: Overfishing

**Climate change**  
Before: Extensive ice caps

**Climate change**  
After: Melting ice caps



© iStockphoto.com/Daniel Kay  
© iStockphoto.com/Josef Friedhuber  
Jonathan Larsen/Diadem Images / Alamy Stock Photo

**Question 8a** (1 mark)

**State** the meaning of the term *biodiversity*.

**Question 8b** (2 marks)

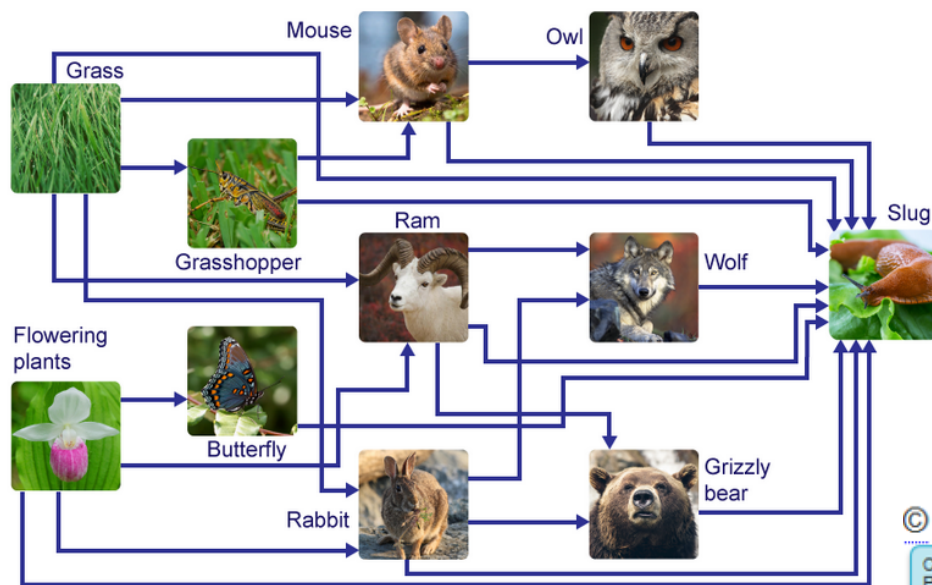
**Outline** how **one** specific human action could reduce biodiversity.

**Question 8c** (4 marks)

**Explain**, using scientific language, how the loss of one species might affect other organisms in the ecosystem.

**Question 9** (5 marks)

This diagram uses pictures of organisms to show connections within an ecosystem.



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Chris Orpin Copyright  
Paul Sundberg Photography  
Rudmer Zwerver / CreativeNature.nl  
© iStockphoto.com/Suzann Julien  
© iStockphoto.com/erwo1

**Question 9a** (1 mark)

**State** the name of this type of diagram.

**Question 9b** (2 marks)

Use the diagram to **state** the roles of the flowering plant and the slug in this ecosystem.

The term *charismatic megafauna* has recently been used to describe endangered animals that have popular appeal. The media have used animals such as gorillas, pandas and tigers to highlight conservation issues. These species, however, do not always have a key role within an ecosystem; if the organisms were removed from the ecosystem, the ecosystem would not collapse. Aesthetic considerations may mean that people might be more interested in protecting an endangered flower but not an endangered slug. Biologists, however, place value on an organism's role within an ecosystem rather than on its appearance.

**Question 9c** (2 marks)

**Justify** using scientific reasoning why each of these organisms are equally important to protect. You must refer to the diagram above in your answer.

flowering plant

slug

**Question 10** (21 marks)

Scientists are preserving the diversity of plants by creating seed banks. Seed banks store seeds from as many plants as possible.



Photograph courtesy Argonne National Laboratory  
© Gane Kumaraswamy  
Alfredo Caliz/Panos

**Question 10a** (1 mark)

**State one** reason why seed banks are important.

**Question 10b** (3 marks)

**Outline** the process used to create a seed bank.

**Question 10c** (17 marks)

**Discuss** and **evaluate** the implications of creating and maintaining seed banks. In this extended piece of writing you should consider:

- the value of seed banks for the conservation of an individual species and whole ecosystems
- the responsibility for creating and maintaining seed banks
- an economic consideration **or** a political consideration.