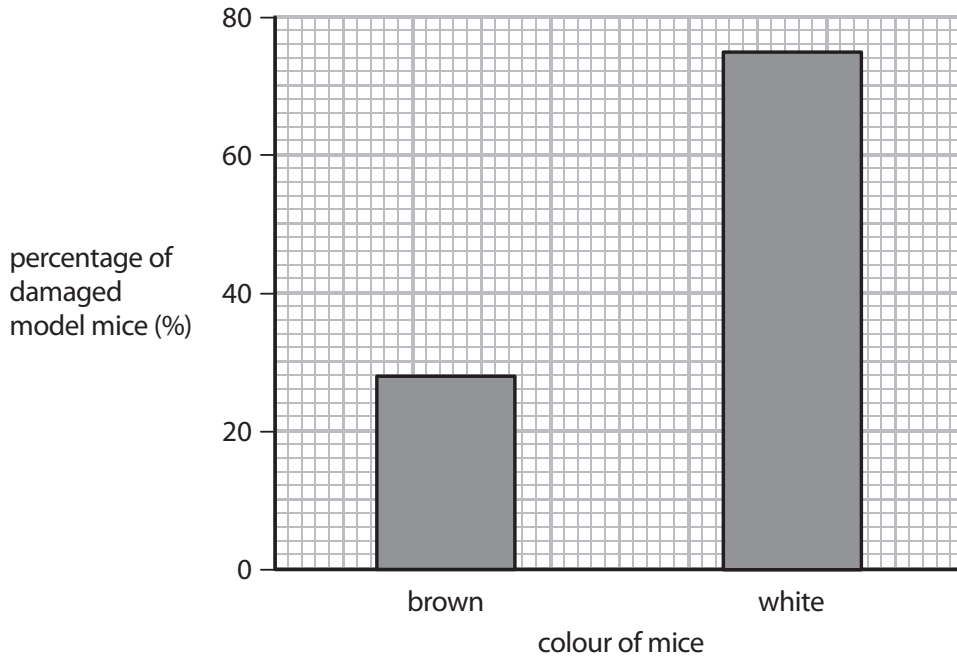


(b) A student uses 400 clay models of mice to investigate natural selection.
He paints 200 of the clay models white and 200 brown.
He places the model mice in woodland in the morning.
He checks the models in the evening for damage by predators.
The graph shows his results.



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- (i) Calculate the difference between the **number** of damaged white model mice and the **number** of damaged brown model mice.

(2)

difference =

- (ii) Suggest why the results would differ if the student used live white mice and live brown mice rather than clay models.

(2)

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(Total for Question 3 = 10 marks)



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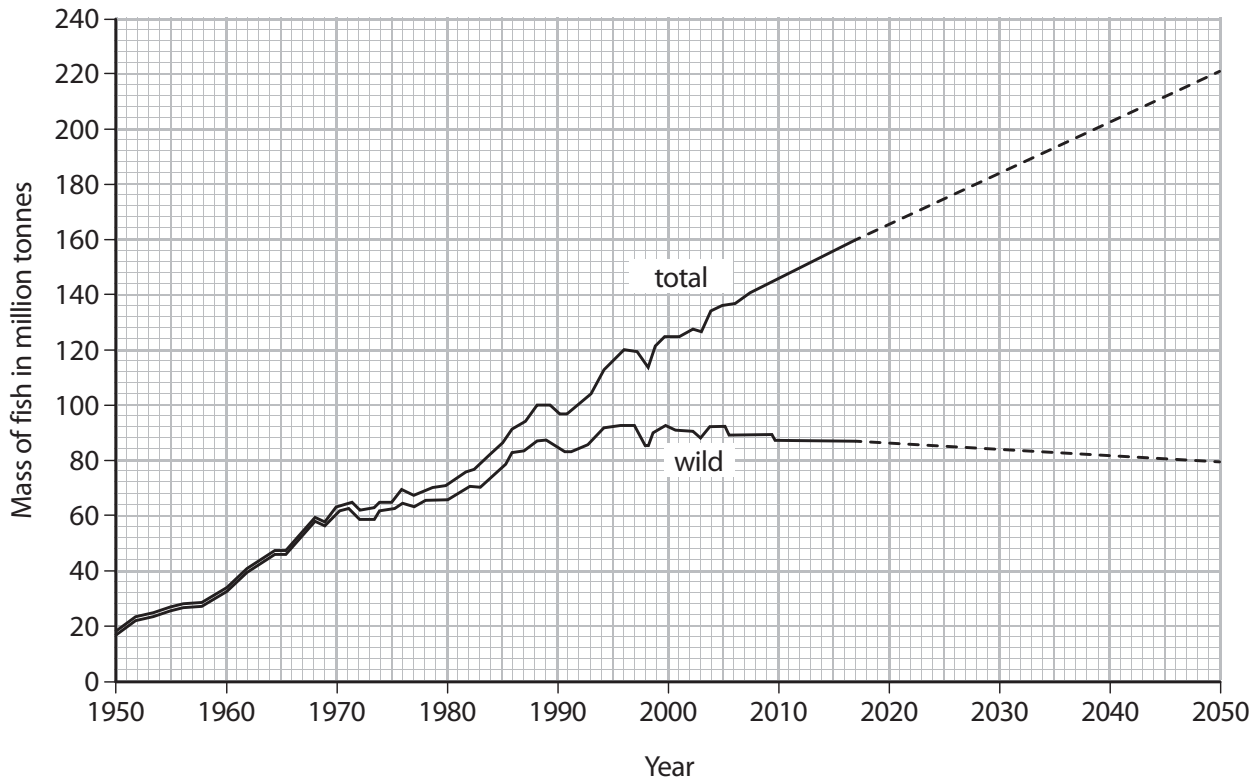
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4 The world supply of wild fish is decreasing.

Fish farming provides an alternative method of supplying fish.

(a) The graph shows the change in total supply of fish and the supply of wild fish between 1950 and 2017.

The graph also shows the predicted total supply of fish and supply of wild fish from 2017 to 2050.



(i) The total supply of fish is the sum of the supply of wild fish and the supply of farmed fish.

Describe the change in the supply of wild fish and the supply of farmed fish between 1950 and 2017.

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(ii) Calculate the predicted rate of increase in the total supply of fish in tonnes per year between 2017 and 2050.

Give your answer in tonnes per year.

Show your working.

(2)

rate of increase = tonnes per year

(b) To increase production, fish farmers maintain water quality and food quality on a fish farm.

Explain three other ways that farmers could increase production on a fish farm.

(6)

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(Total for Question 4 = 10 marks)



5 A student investigates the effect of deforestation on the number of insects living in the soil. She uses a quadrat to sample the soil from two areas in an oak forest. One area has trees growing. The other area has been deforested. She compares the number of insects in each area. The table shows her results.

Area	Average (mean) number of insects per m ²
trees growing	1943
deforested	40

(a) Name the independent variable in this investigation. (1)

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(b) Suggest an explanation for these results. (2)

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(c) The student's results are valid and reliable. Suggest how the student made sure that her results were valid and reliable. (3)

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(d) The student claims her results show that deforestation should be prevented.

What are the advantages and disadvantages of deforestation?

(6)

Area with horizontal dotted lines for writing the answer.

(Total for Question 5 = 12 marks)

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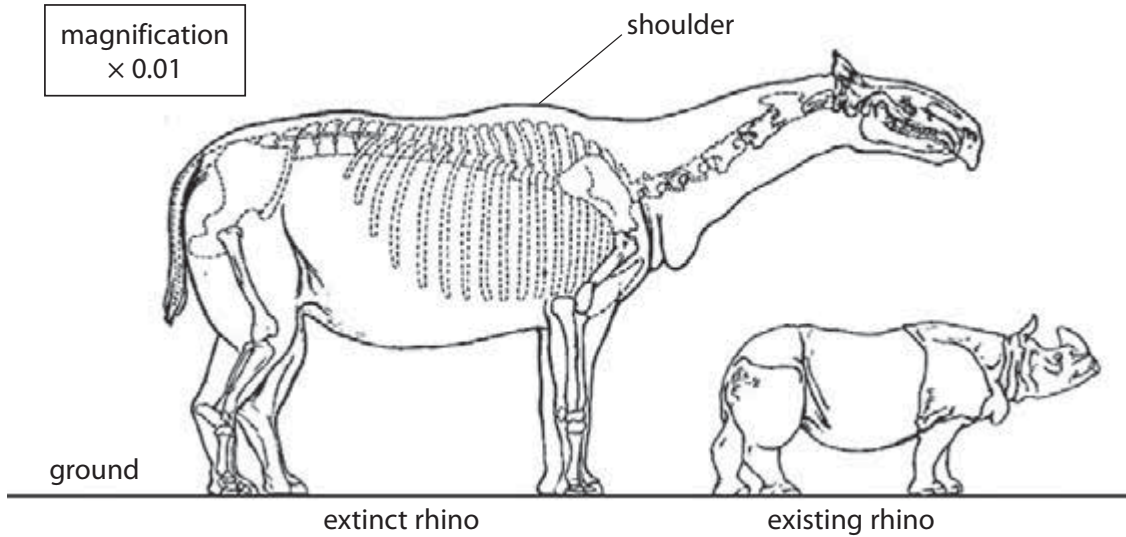
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- 6 One of the largest land mammals ever known is an extinct species of rhino that lived in Mongolia.

The diagram compares the size of the extinct rhino with an existing rhino.



- (a) Using the scale on the diagram, calculate the shoulder height of the extinct (large) rhino. Give your answer in metres.

(2)

height of shoulder = metres



(b) Some people think that the large rhino became extinct because of global warming.

Suggest how global warming could have made it difficult for the large rhino to maintain a constant body temperature.

(2)

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(c) Suggest two factors, other than global warming, that may have caused the large rhino to become extinct.

(2)

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(Total for Question 6 = 6 marks)

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7 All living cells contain enzymes.

(a) Describe the role of enzymes in cells.

(2)

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(b) The table lists some enzymes, where they are produced and their function.

Complete the table by giving the missing information.

(5)

Enzyme	Where produced	Function
amylase	salivary gland	
protease		
	bacteria	cutting DNA at certain points
ligase	cell nucleus	

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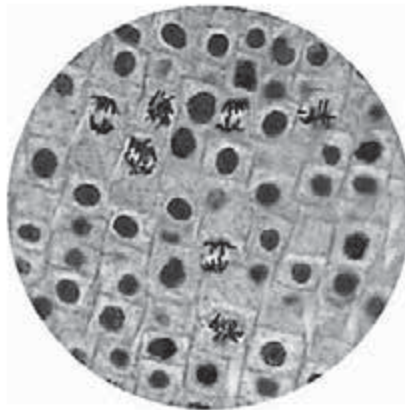
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8 Plant roots grow when cells in the root tip divide by mitosis.

Cells in the process of dividing by mitosis can be identified because their chromosomes become visible when viewed with a microscope.

The photograph shows the cells of a squashed root tip seen using a microscope.



(a) How many cells in this diagram are dividing by mitosis?

(1)

(b) Scientists measure growth in root tips by calculating the mitotic index.

The equation shows how to calculate the mitotic index.

$$\text{mitotic index} = \frac{\text{number of cells showing mitosis}}{\text{total number of cells}} \times 100$$

Root tips that are growing rapidly have a high mitotic index.

(i) Calculate the mitotic index for a root tip with 9 cells showing mitosis and 110 cells not showing mitosis.

(2)

mitotic index =

(ii) Explain why it is difficult to obtain the data to calculate the mitotic index.

(2)

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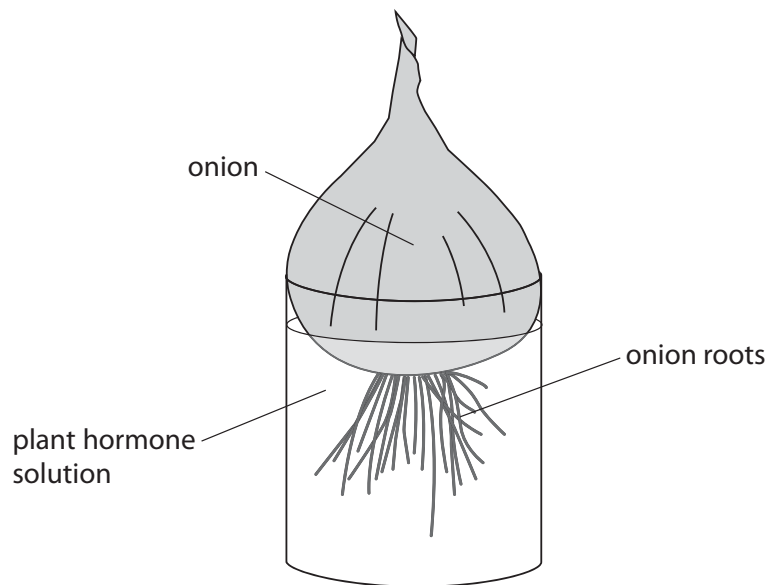
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- (c) A student uses this apparatus to investigate the effect of a plant hormone on the mitotic index in onion roots.



The student puts onions in different concentrations of plant hormone solution.

She then squashes samples of the root tips and calculates the average (mean) mitotic index for each concentration.

The table shows her results.

Concentration of plant hormone in parts per million	Average mitotic index
0.0	4.65
0.005	9.65
0.05	6.55
0.5	4.10

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(i) Describe the results of this investigation.

(2)

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(ii) Name three abiotic (non-living) factors that the student should control in her investigation.

(3)

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(Total for Question 8 = 10 marks)

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- 9 NASA (the National Aeronautics and Space Administration) is investigating how to grow plants on space stations.

As part of their investigation, NASA scientists looked at the effect of using different types of lamp on the rate of photosynthesis in spinach plants.

- (a) Explain why the scientists expected a link between rate of photosynthesis and biomass produced.

(2)

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- (b) The scientists measured the rate of photosynthesis and the biomass produced for different types of lamp.

The table shows their results.

Type of lamp	Rate of photosynthesis in arbitrary units	Biomass produced in g / m ²
fluorescent	6.8	6.0
sodium	6.7	8.8
LED 660	6.5	7.8
LED 670	8.3	8.2
LED 680	10.1	7.8
LED 690	9.1	9.0

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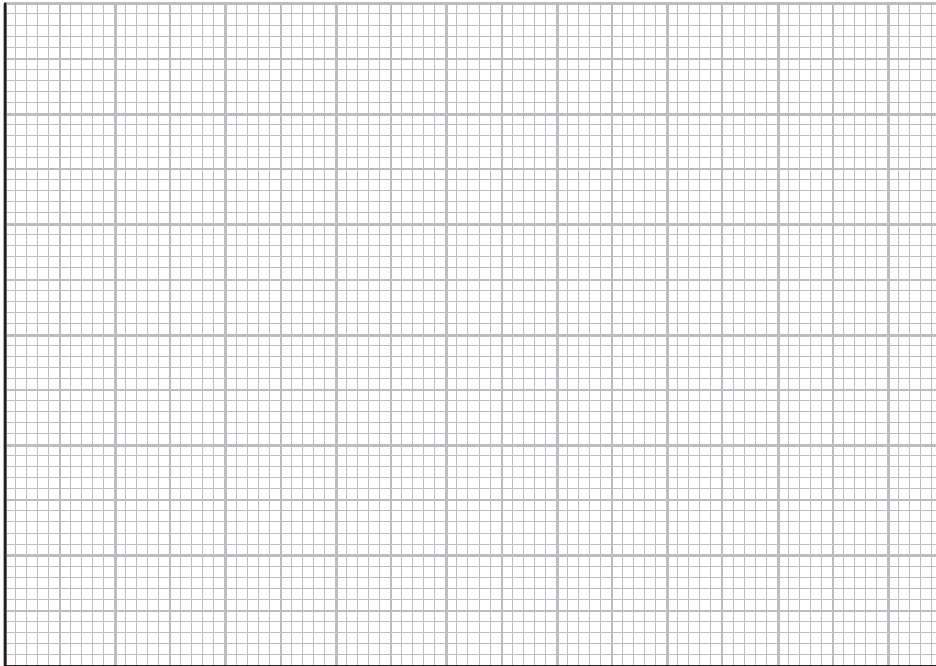
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(i) Plot a bar graph to show the biomass produced for each type of lamp.

(5)



(ii) Suggest why the rate of photosynthesis and the biomass produced do not follow a similar pattern.

(2)

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(c) Suggest which lamp would be best for a spinach grower to use in his glasshouse. (2)

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(d) Name three factors, other than light, that would affect the rate of photosynthesis. (3)

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(e) Suggest why NASA is investigating how to grow plants in space stations. (1)

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(Total for Question 9 = 15 marks)

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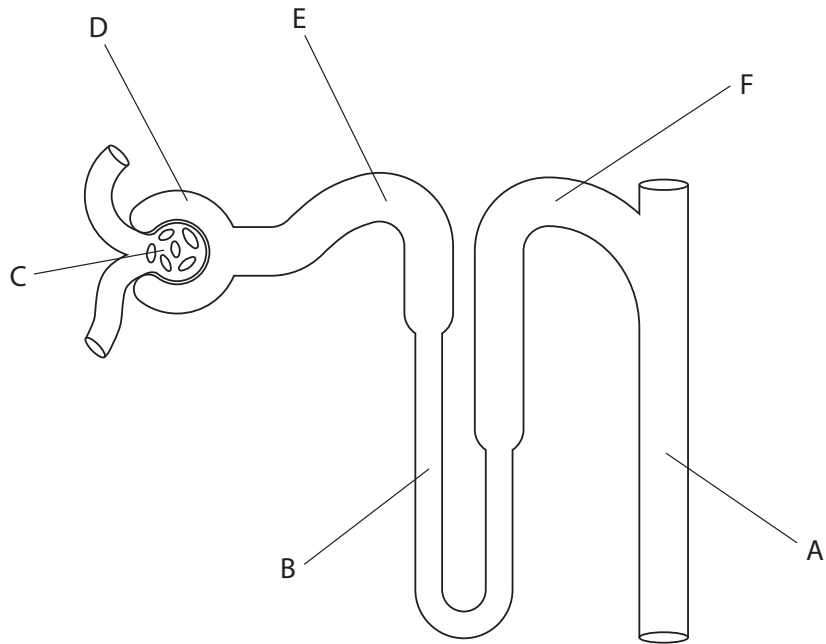
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10 The diagram shows a nephron from a human kidney.



(a) Name the structures labelled A, B, C and D.

(4)

A

B

C

D

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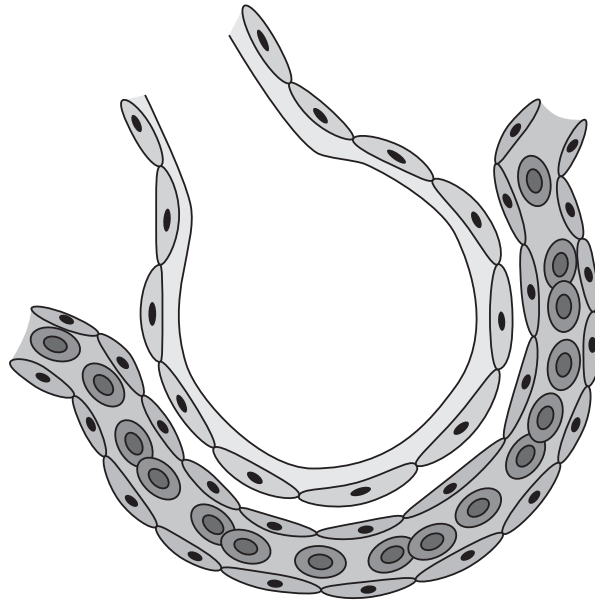
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- 11 Human lungs and plant leaves both contain gas exchange surfaces. These gas exchange surfaces have a number of features in common.
- (a) The diagram shows a cross-section through human lung tissue.



Explain, with reference to features shown in the diagram, how lung tissue enables efficient gas exchange.

(4)

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