PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



EXAM QUESTION PACK

TOPIC 10: ECOSYSTEMS

ENERGY TRANSFER THROUGH ECOSYSTEMS

SCORE	PERCENTAGE
/66	%

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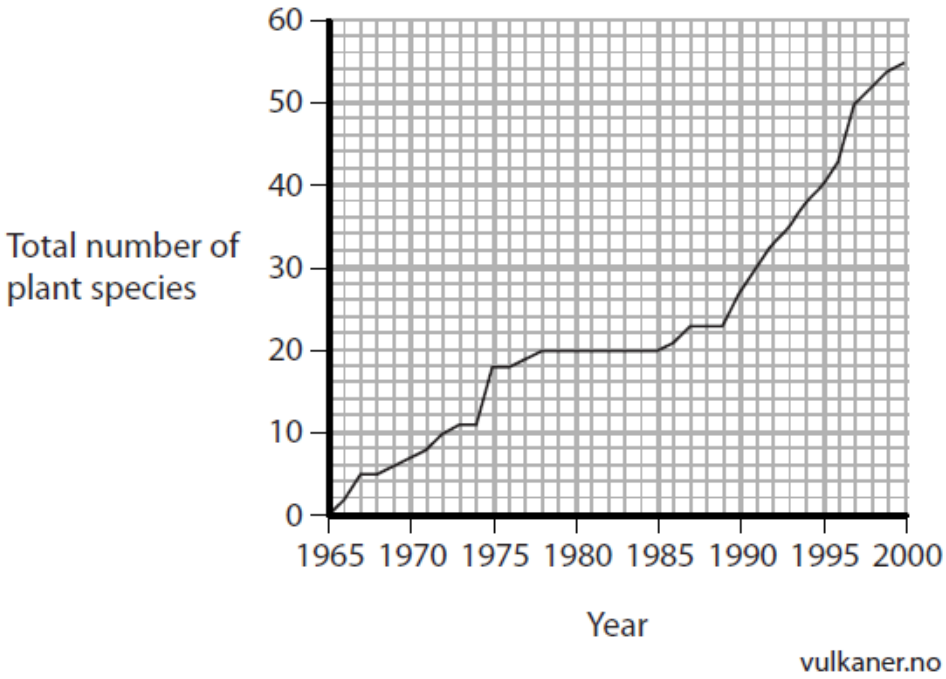
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Q1.

The scientists recorded the number of different plant species on the island each year from 1965 to 2000.

The number of new plant species present at each survey was recorded.

The graph shows the total number of plant species that have been found on the island.



A few groups of one species of seagull arrived on the island in 1974.

In 1985 a large group of a different species of seagull, the black-backed gull, arrived on the island.

Comment on the effects of these two species of seagull on the number of plant species.

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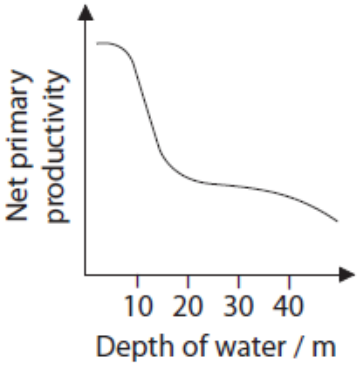
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Q2.

The graph below shows how the depth of water in a freshwater lake affects the net primary productivity (NPP).



Place a cross ☒ in the box next to the equation that describes the relationship between NPP, gross primary productivity (GPP) and respiration (R).

(1)

☒ **A** GPP = R – NPP

☒ **B** NPP = GPP – R

☒ **C** NPP = GPP + R

☒ **D** R = GPP + NPP

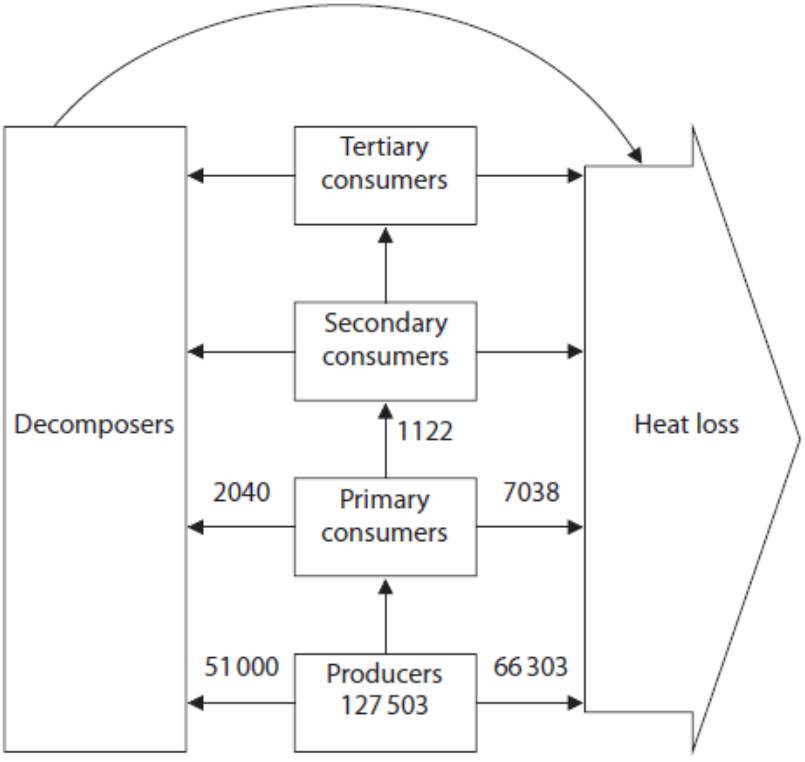
Q3.

The table shows information about one area of the North Atlantic Ocean.

Month	Mean hours of daylight / hr	Mean monthly temperature / °C	Net primary productivity (NPP) / g carbon m^{-2} day^{-1}
January	9.0	2.8	−1.0
February	10.0	3.1	−1.2
March	11.0	6.7	−0.5
April	13.0	9.4	+3.0
May	14.0	15.5	+4.0
June	15.0	20.6	+8.0
July	14.0	23.9	+7.0
August	13.5	23.3	+7.0
September	12.0	21.1	+5.0
October	11.0	16.1	+4.0
November	10.0	11.1	+3.0
December	9.0	4.0	−1.2

The diagram shows some of the energy transfers through a food chain from this area.

The figures show the energy transfer in kJ m^{-2} yr^{-1}.



(i) Calculate the percentage efficiency of energy transfer from the producers to the primary consumers.

(2)

Answer .....

(ii) Explain why the efficiency of energy transfer differs between different trophic levels.

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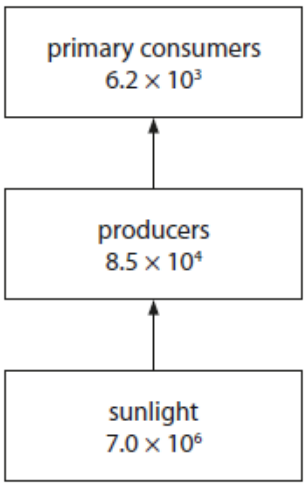
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(Total for question = 5 marks)

Q4.

The diagram shows the flow of energy in an ecosystem.

The numbers represent the energy in kJ m^{-2} yr^{-1} in each category.



(i) Calculate the percentage efficiency of energy transfer from sunlight to the producers.

(2)

Answer ..... %

(ii) Give one reason why the energy transfer from sunlight to the producers is less than 100% efficient.

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(iii) Explain the energy difference between the producers and the primary consumers.

(2)

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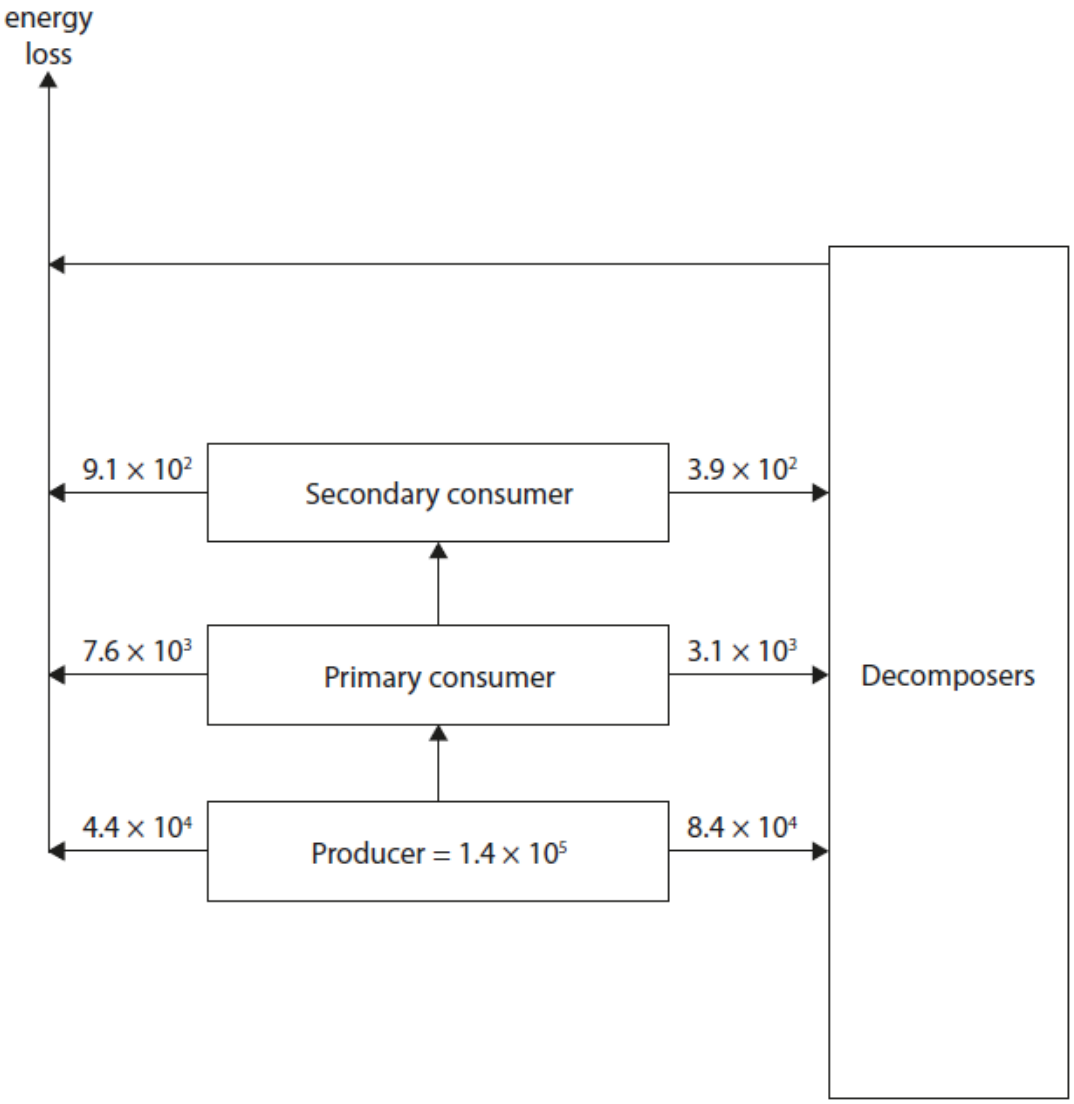
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(Total for question = 5 marks)

Q5.

(i) The diagram shows the transfer of energy through a grassland food chain.

All values are given in kJ m^{-2} yr^{-1}.



Calculate the percentage efficiency of the energy transfer from the producer to the primary consumer.

(2)

Answer .....

(ii) Explain the differences in the efficiency of energy transfer between the trophic levels in a food chain.

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(Total for question = 5 marks)

Q6.

Gilbert's potoroo is one of the most critically endangered species in the world.

Gilbert's potoroo was thought to be extinct until one was found in 1994.

It is thought that there are only 70 individuals.

The photograph shows a potoroo and its pouched baby feeding on berries.



The map shows the only part of Australia where Gilbert's potoroo is found.



The diet of Gilbert's potoroo is about 90% fungi.

Analysis has shown that the fungal spores are spread in the faeces of the potoroos.

These spores then germinate.

Explain the advantage to the ecosystem of fungal spores being spread by potoroos.

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(Total for question = 2 marks)

Q7.

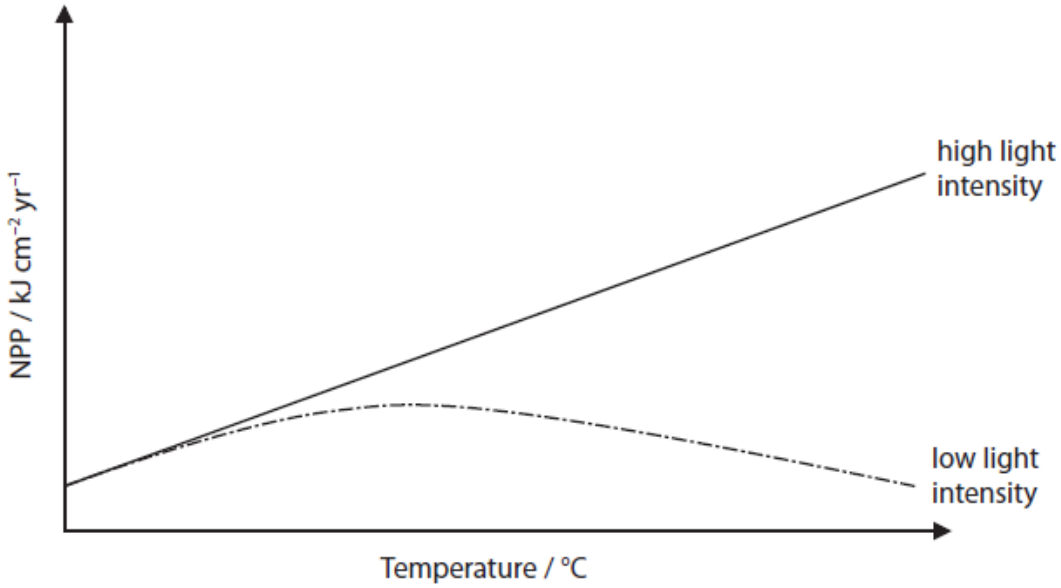
The effects of light intensity and temperature on the net primary productivity (NPP) of young willow trees were investigated.

Young willow trees were grown in two greenhouses: one with high light intensity and one with low light intensity.

In each greenhouse, groups of these willow trees were kept at different temperatures for six

months.

The results are shown in the graph.



* In a further investigation, succession was monitored for fifty years in an abandoned field.

The field was originally used to grow crops.

After fifty years, large numbers of coniferous trees were growing in the field.

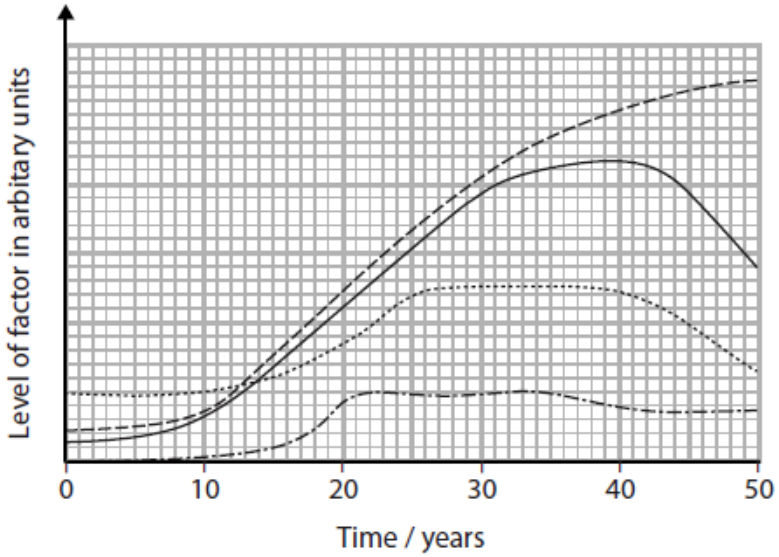
These coniferous trees do not shed many leaves.

When compared with younger trees, older coniferous trees have a much higher proportion of tree stem, branches and roots and a lower proportion of leaves.

The following factors were monitored:

- plant biomass
- NPP
- mineral ion content of soil
- index of diversity of animals

The line graphs show the trends that happened over fifty years for each of the factors.



Key

——— plant biomass

—— NPP

------- mineral ion content of soil

—–—– index of diversity of animals

Analyse the data to explain how succession is linked to the changes in this abandoned field.

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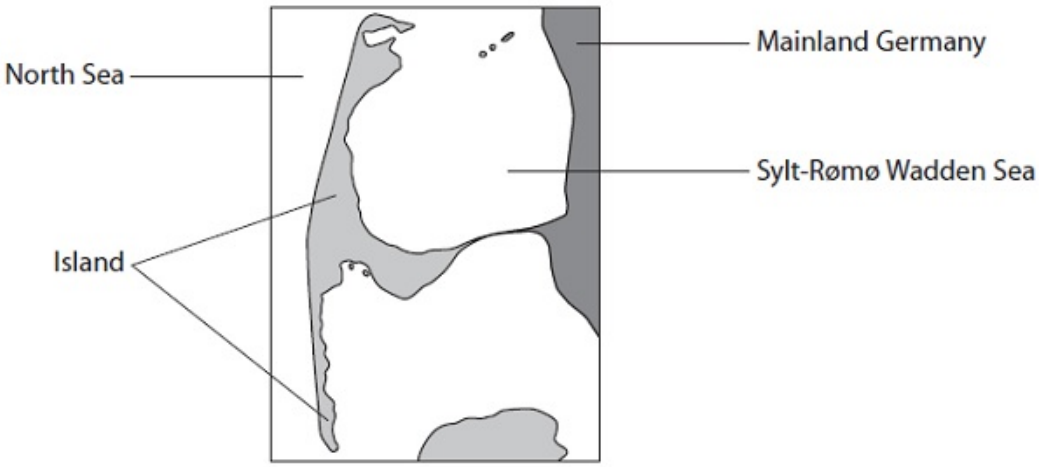
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(Total for question = 6 marks)

Q8. The Sylt-Rømø Wadden Sea, shown in the diagram below, has a high gross primary productivity (GPP) which is monitored constantly.

The Sylt-Rømø Wadden Sea is protected from the North Sea by an island.

There are no large rivers flowing into the Sylt-Rømø Wadden Sea.



(a) Explain the meaning of the term **gross primary productivity (GPP)**.

(2)

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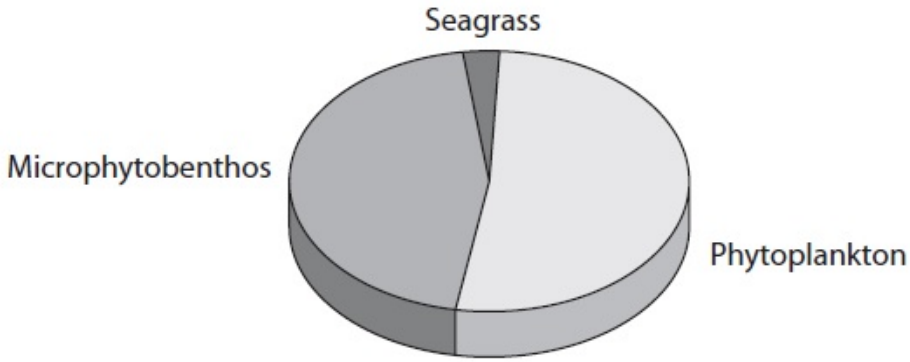
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(b) Seagrass, microphytobenthos and phytoplankton are the producers found in the Sylt-Rømø Wadden Sea.

The chart below shows the distribution of GPP between these producers.



(i) Using the chart, describe the distribution of GPP in this sea.

(2)

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(ii) The total GPP for this sea is 840×10^6 kJ m^{-2} y^{-1}.

Explain how GPP for the phytoplankton could be calculated.

(2)

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(iii) Suggest why GPP for this sea is very high.

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(c) Explain why net primary productivity (NPP) is lower than GPP.

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(Total for Question = 10 marks)

Q9.

Grassland is an important habitat for grazing animals such as cattle.

Fields used for grazing cattle must have a high gross primary productivity.

State what is meant by the term gross primary productivity and include the units in which it is measured.

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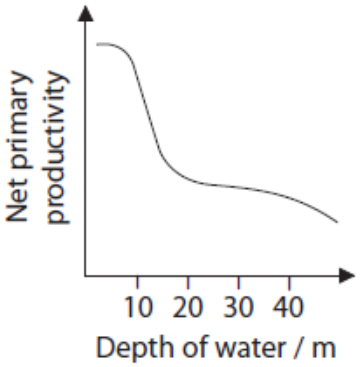
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(Total for question = 2 marks)

Q10.

The graph below shows how the depth of water in a freshwater lake affects the net primary productivity (NPP).



Place a cross ☒ in the box next to the units that should appear on the *y*-axis of this graph.

(1)

☒ **A** kg

☒ **B** kJ m-1

☒ **C** kJ m^{-2} $year^{-1}$

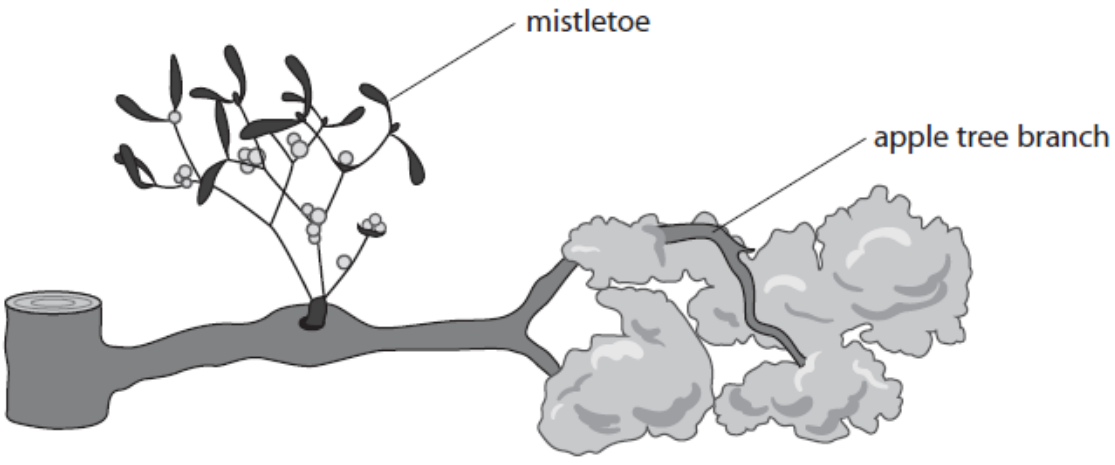
☒ **D** kg m^{-1} $year^{-1}$

Q11.

*Mistletoe is a plant that is a parasite on trees.

Mistletoe has green leaves. Mistletoe also has a modified root that grows into the xylem of a tree.

The diagram shows mistletoe growing on an apple tree branch.



The effect of mistletoe on the growth of apple trees was investigated.

Every year for 20 years, scientists selected apple trees infected with mistletoe and measured

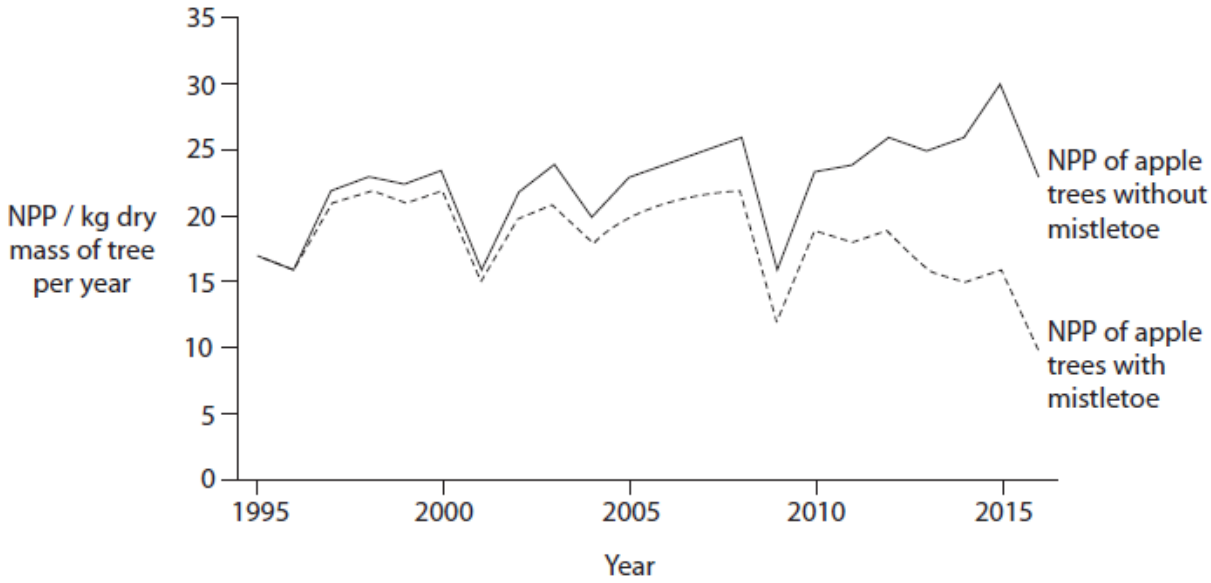
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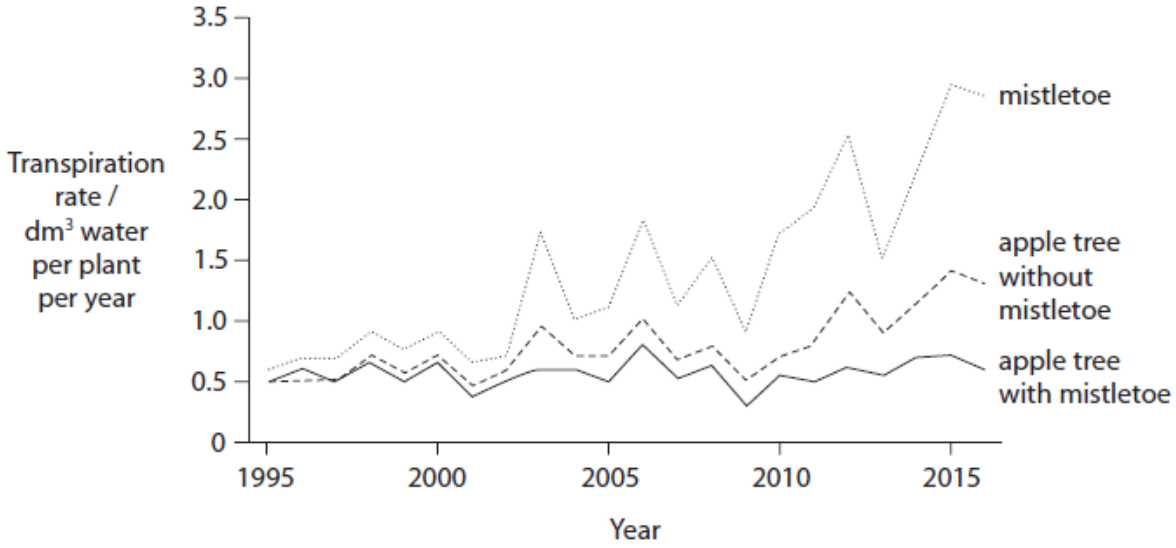
- mean net primary productivity (NPP) of the apple trees
- transpiration rate of the apple trees
- transpiration rate of the mistletoe branches on the apple trees

They also determined the mineral content of the apple tree leaves after 20 years.

A control group of apple trees not infected with mistletoe was included in this investigation.

The graphs and table show the results of the investigation.





Apple tree leaves from	Nitrogen content / mg per g of leaf	Calcium content / mg per g of leaf
trees infected with mistletoe	8.50	6.45
trees not infected with mistletoe	10.60	8.90

Analyse the data to explain the effect of mistletoe on the NPP of apple trees.

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(Total for question = 6 marks)

Q12.

The table shows information about one area of the North Atlantic Ocean.

Month	Mean hours of daylight / hr	Mean monthly temperature / °C	Net primary productivity (NPP) / g carbon m^{-2} day^{-1}
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February	10.0	3.1	−1.2
March	11.0	6.7	−0.5
April	13.0	9.4	+3.0
May	14.0	15.5	+4.0
June	15.0	20.6	+8.0
July	14.0	23.9	+7.0
August	13.5	23.3	+7.0
September	12.0	21.1	+5.0
October	11.0	16.1	+4.0
November	10.0	11.1	+3.0
December	9.0	4.0	−1.2

(i) State what is meant by the term **net primary productivity** (NPP).

(1)

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(ii) Analyse the data to explain the effect of daylight and temperature on NPP.

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(Total for question = 4 marks)

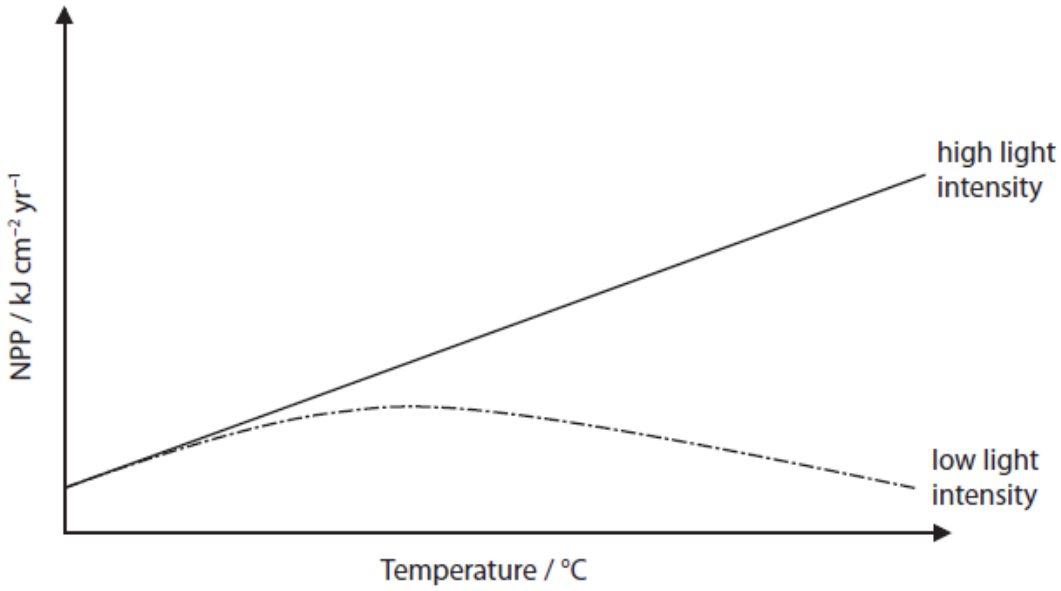
Q13.

The effects of light intensity and temperature on the net primary productivity (NPP) of young willow trees were investigated.

Young willow trees were grown in two greenhouses: one with high light intensity and one with low light intensity.

In each greenhouse, groups of these willow trees were kept at different temperatures for six months.

The results are shown in the graph.



(i) State what is meant by the term net primary productivity.

(1)

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(ii) Explain why temperature has different effects on NPP at these two light intensities.

(2)

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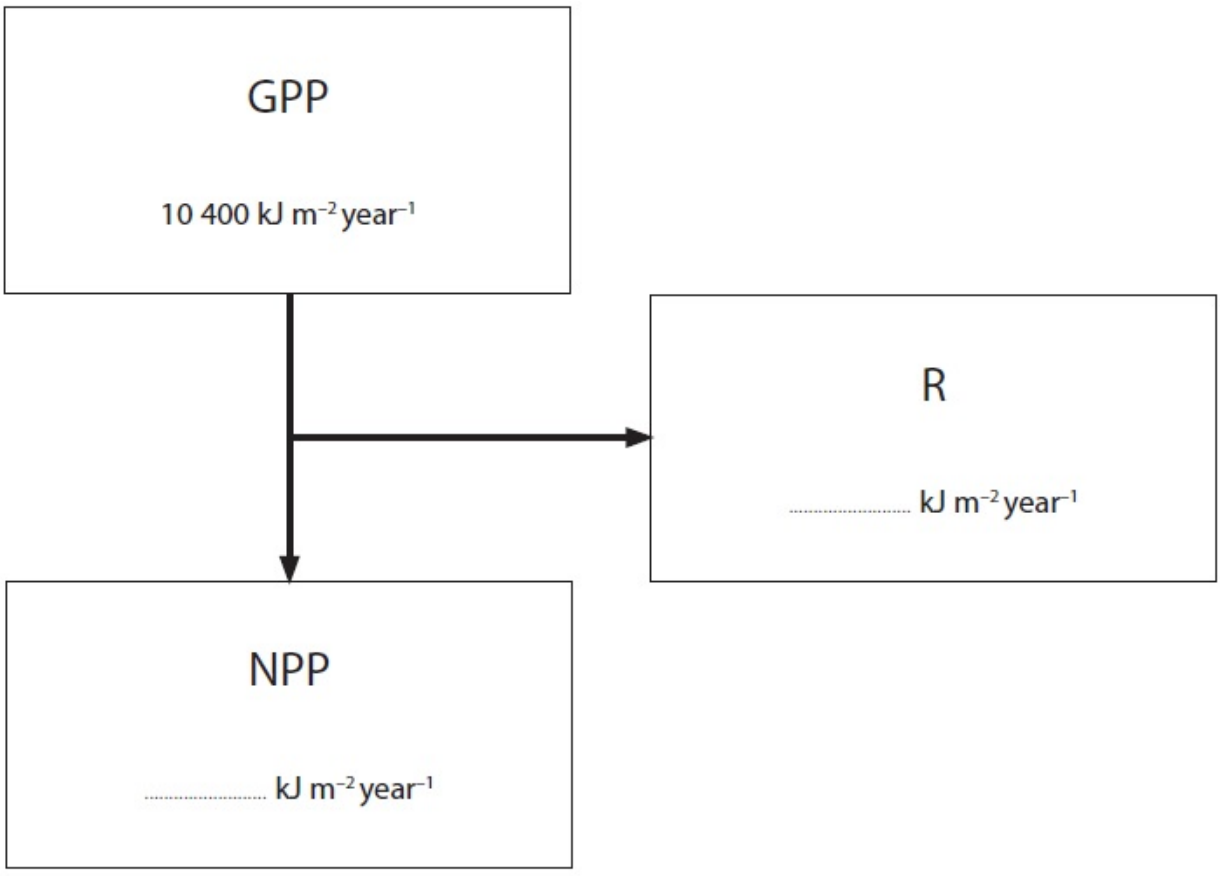
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(Total for question = 3 marks)

Q14. Farmers find it helpful to know the productivity of their land.

The diagram below shows the relationship between GPP (gross primary productivity), NPP (net primary productivity) and R (plant respiration) for an area of grassland.



(a) The efficiency of the transfer of energy from GPP to NPP for this grassland is 45%.

(i) Calculate the values for NPP and R. Write your answers in the diagram above.

(2)

(ii) Using the information given, explain the relationship between GPP and NPP.

(3)

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(b) Suggest why NPP values would be of use to a farmer who wanted to use this land for cattle.

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(c) The units (kJ m^{-2} $year^{-1}$) used in the diagram show a rate of energy production. Suggest why this is more useful than measurements of biomass in the grassland on a particular day.

(2)

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(Total for Question = 10 marks)

Q15.

Grassland is an important habitat for grazing animals such as cattle.

Cattle graze on the plants on grassland.

Describe what happens to the energy in the plants that are not eaten by cattle.

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(Total for question = 2 marks)