

- 1 The decomposition of leaves depends on the content of the leaves, the presence of certain microorganisms and a number of abiotic factors.

Leaves consist of a number of organic molecules, including lignin and cellulose.

- (a) Place a cross  in the box next to the groups of microorganisms that all cause decomposition.

(1)

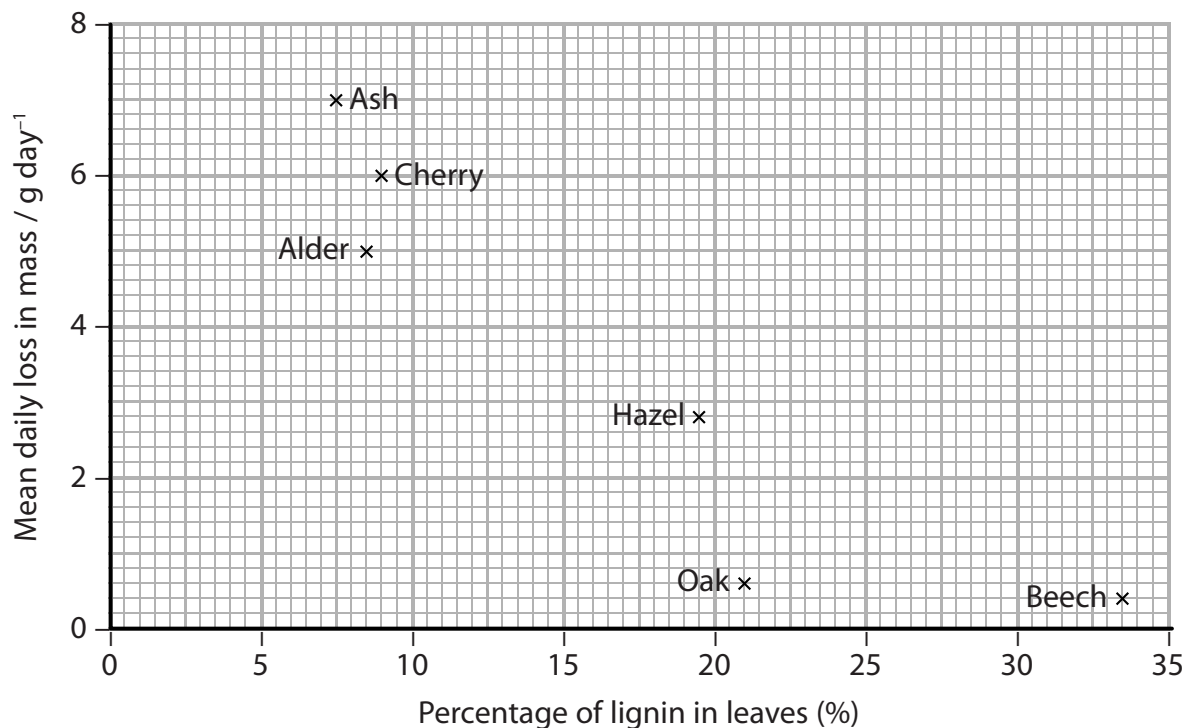
- A** bacteria and fungi
- B** bacteria and viruses
- C** fungi and viruses
- D** bacteria, fungi and viruses

- (b) An investigation was carried out into the effect of lignin content on the decomposition of leaves from different types of tree.

The lignin content of leaves from an ash tree was determined. A pile of ash leaves was collected and weighed. The leaves were left for 40 days and reweighed. The mean daily loss in mass was calculated.

This was repeated for leaves from five other species of tree. All six piles of leaves had the same starting mass.

The results of this investigation are shown in the graph below.



(i) A student made the following conclusions from the data.

Beech leaves decompose faster than cherry leaves.

Microorganisms are needed for the decomposition of these leaves.

There is a causal relationship between lignin content and decomposition.

Place a cross ☒ in the box next to the number of correct conclusions made by the student.

(1)

**A** none

**B** one

**C** two

**D** three

(ii) Place a cross ☒ in the box next to the term that completes the following statement.

Each pile of leaves had the same mass to ensure the investigation was

(1)

**A** accurate

**B** precise

**C** reliable

**D** valid

(iii) Suggest what happens to the cellulose in these leaves during decomposition.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(iv) The student repeated this investigation on sycamore leaves.

Explain why it would be necessary to keep the temperature of this investigation the same as the original.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

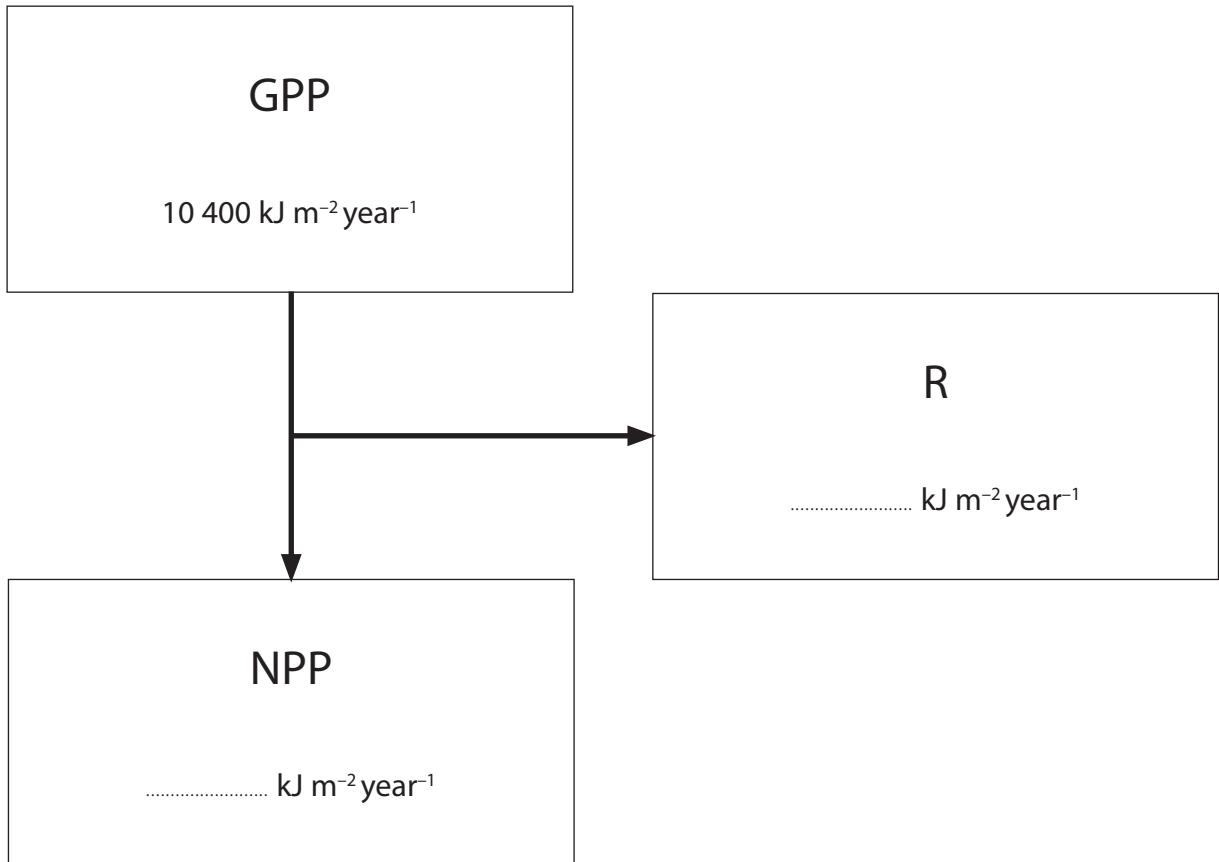
.....

.....

**(Total for Question 1 = 11 marks)**

2 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)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(c) The units ( $\text{kJ m}^{-2}\text{year}^{-1}$ ) 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)

.....

.....

.....

.....

- 3 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)

.....

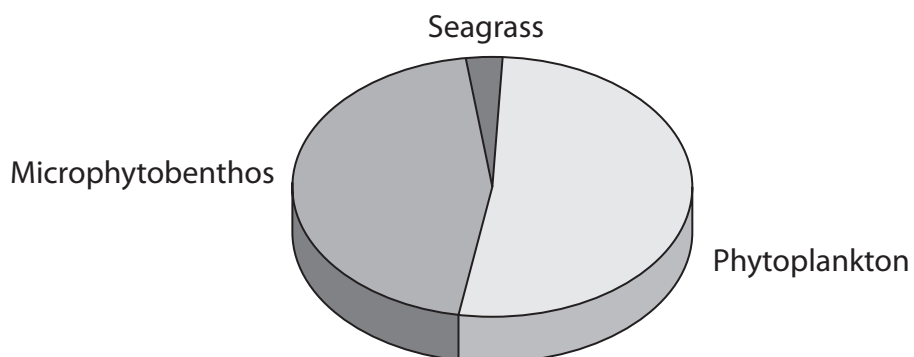
.....

.....

.....

- (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)

.....

.....

.....

.....

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

Explain how GPP for the phytoplankton could be calculated.

(2)

.....

.....

.....

.....

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

(2)

.....

.....

.....

.....

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

(2)

.....

.....

.....

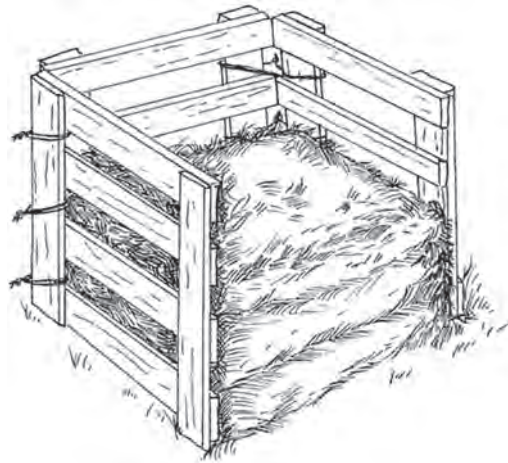
.....

---

**(Total for Question 3 = 10 marks)**

- 4 Waste plant material from gardens can be turned into a bulk organic fertiliser known as compost. Compost consists of semi-decomposed material which can add texture and mineral nutrients to the soil.

The diagram below shows a typical garden compost bin.



- (a) Place a cross ☒ in the boxes next to the **two** types of organism that would be able to decompose organic compounds in waste plant material.

(2)

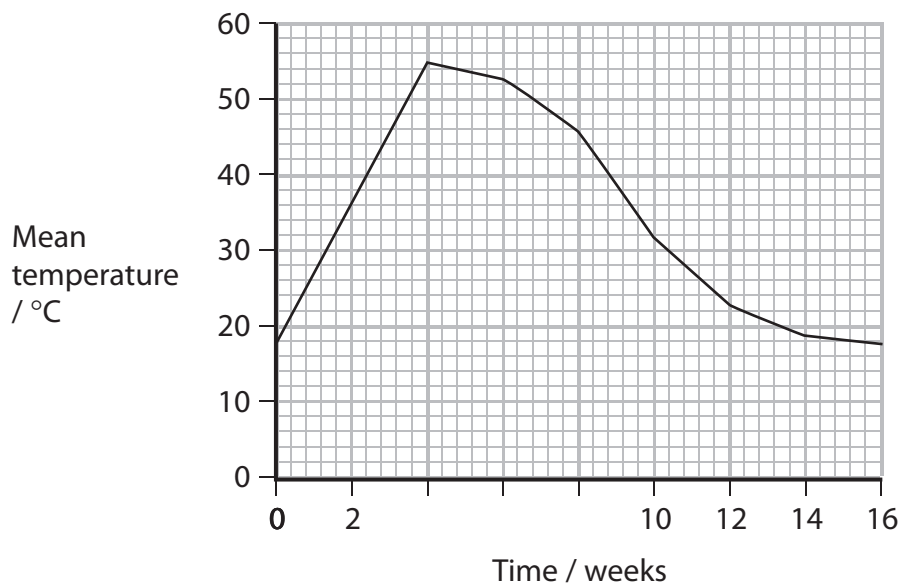
- A** algae
- B** bacteria
- C** fungi
- D** viruses



(b) As part of a study of compost formation, a student monitored the temperature in a compost heap for several weeks. A compost heap was set up using a mixture of leaves, straw and other plant material.

The student added some nitrate fertiliser and watered the compost heap. The temperature was measured in the compost heap by inserting a long thermometer at several points. The temperature readings were repeated for a further 16 weeks.

The graph below shows the results of this part of the study.



The table below shows statements that the student wrote in her report on the study. Place a tick (✓) in each row to indicate whether the statement is true or false.

(3)

| Statement   | True | False |
|---|------|-------|
| Compost formation involves respiration by microorganisms.                             |      |       |
| I added nitrate fertiliser so that the microorganisms could synthesise nucleic acids. |      |       |
| There is only one trophic level in my compost heap.                                   |      |       |

(c) Describe the changes in temperature shown in the graph.  
Suggest explanations for these changes.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(d) Suggest why the student took temperature measurements by using **a long thermometer at several points.**

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....