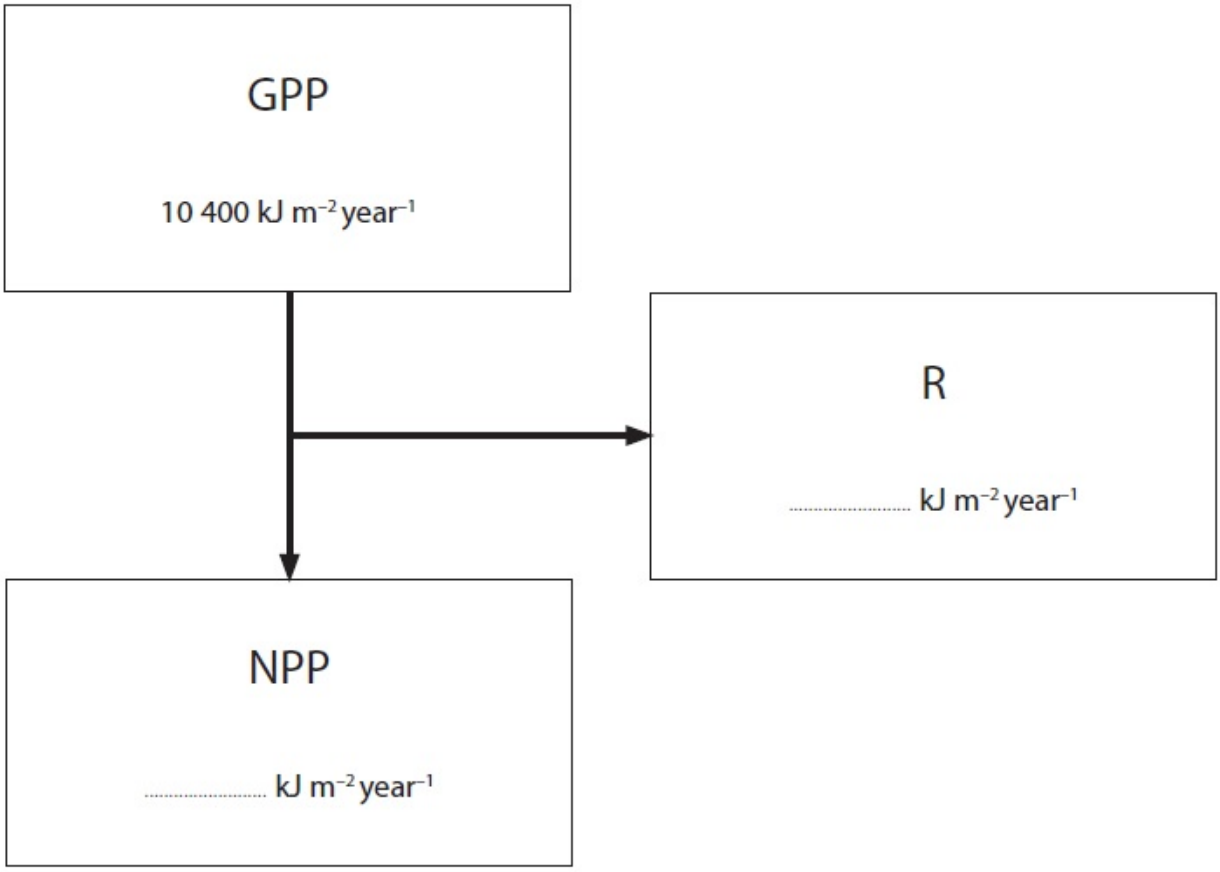
Q1. Farmers find it helpful to know the productivity of their land.

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.

(3)

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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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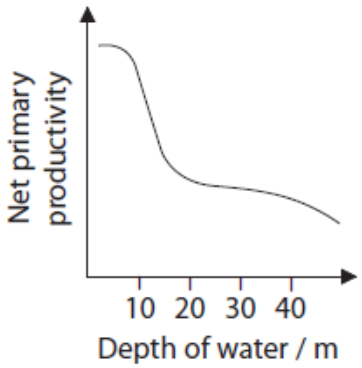
(Total for Question = 10 marks)

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 units that should appear on the *y*-axis of this graph.

(1)

☒ **A** kg

☒ **B** kJ m-1

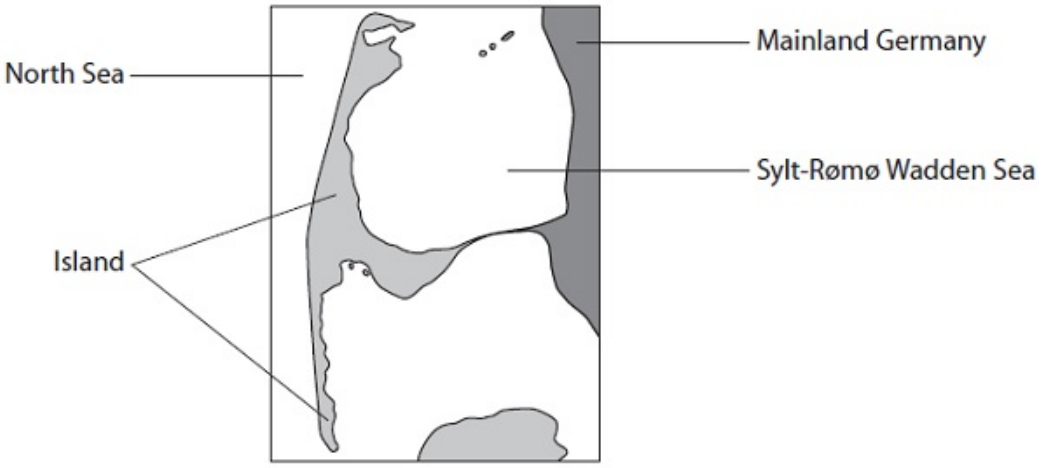
☒ **C** kJ m^{-2} $year^{-1}$

☒ **D** kg m^{-1} $year^{-1}$

Q3. 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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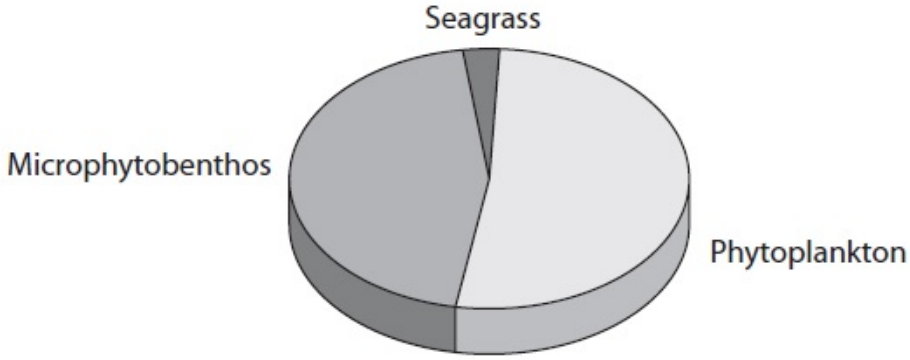
(b) Seagrass, microphytobenthos and phytoplankton are the producers found in the Sylt-Rømø Wadden Sea.

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.

(2)

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

(2)

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(Total for Question = 10 marks)

Q4.

The photograph shows heather, *Calluna vulgaris*, a plant that grows on moorland.

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In an investigation into the net primary productivity of heather, all the vegetation on an area of two different moorlands, A and B, was removed by burning. The dry biomass, in g m^{-2}, was then measured each year for a period of 20 years.

(a) Give an equation that shows the relationship between gross primary productivity, net primary productivity and respiration.

(1)

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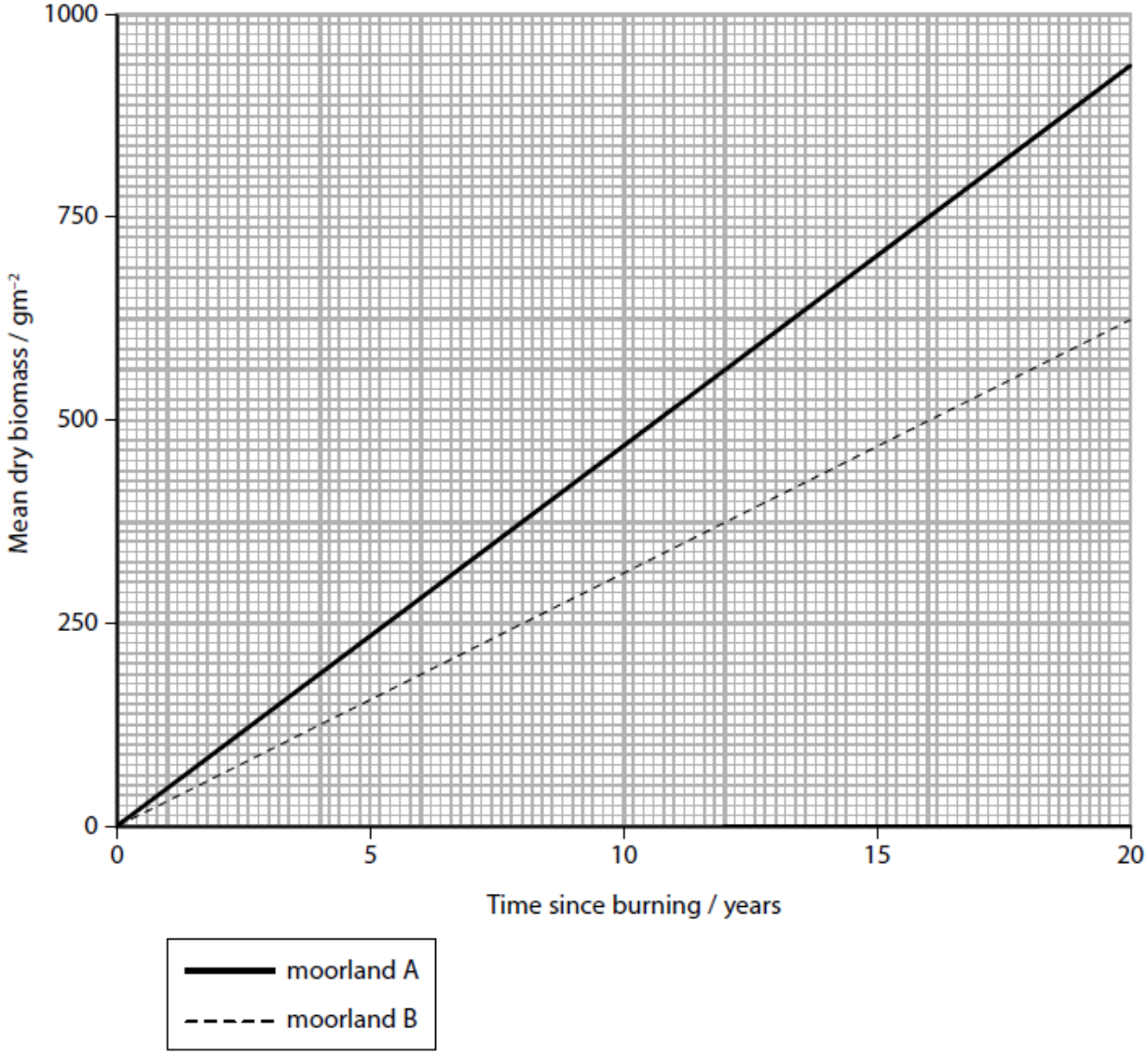
(b) The graph shows the change in the mean dry biomass of the heather plants during the 20 year period.



(i) Describe a method that could be used to obtain the mean dry biomass of the heather plants in year 20.

(2)

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(ii) The total solar radiation reaching moorland A was 3 144 000 kJ m^{-2} yr^{-1}. Each gram of dry heather contains 22.186 kJ.

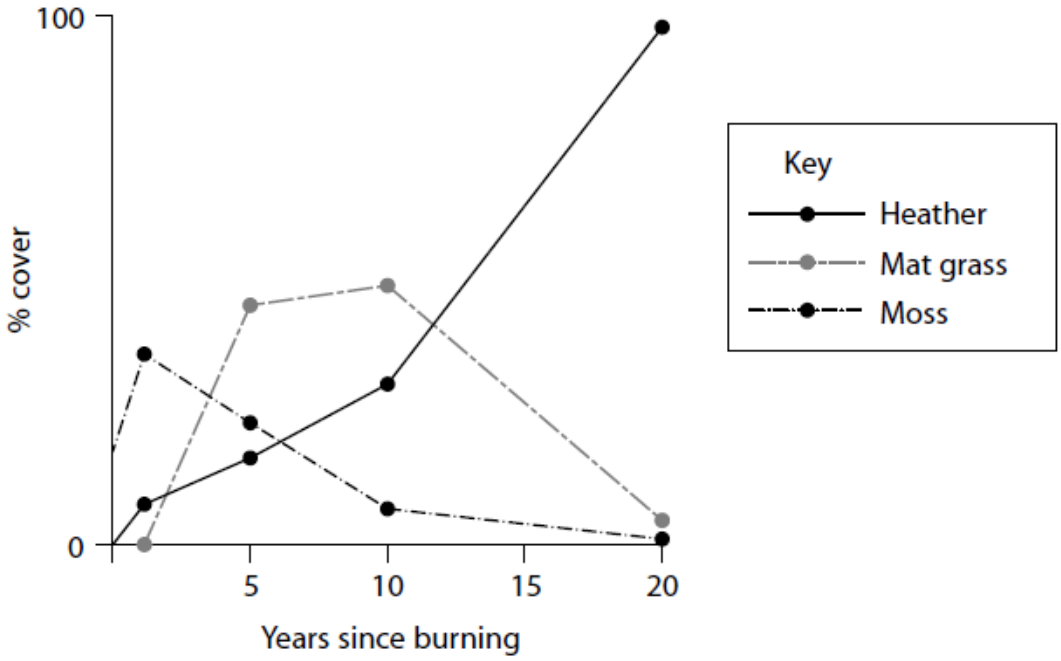
Calculate the percentage efficiency of heather plants from moorland **A** at converting solar radiation into dry biomass.

(2)

Answer .....

(iii) After the burning of the moorland, a process of succession occurred.

The following information shows some of the changes found over the 20 years.



Analyse the data to explain the changes shown.

(3)

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(Total for question = 8 marks)