

(a) Suggest an explanation for the following:

(i) Maize is the most important cereal crop in hot, dry climates.

.....  
.....  
.....

[3]

(ii) The outer surface of rice leaves is hydrophobic.

.....  
.....

[2]

(b) Sorghum is a xerophytic cereal.

(i) What is a xerophyte?

.....

[1]

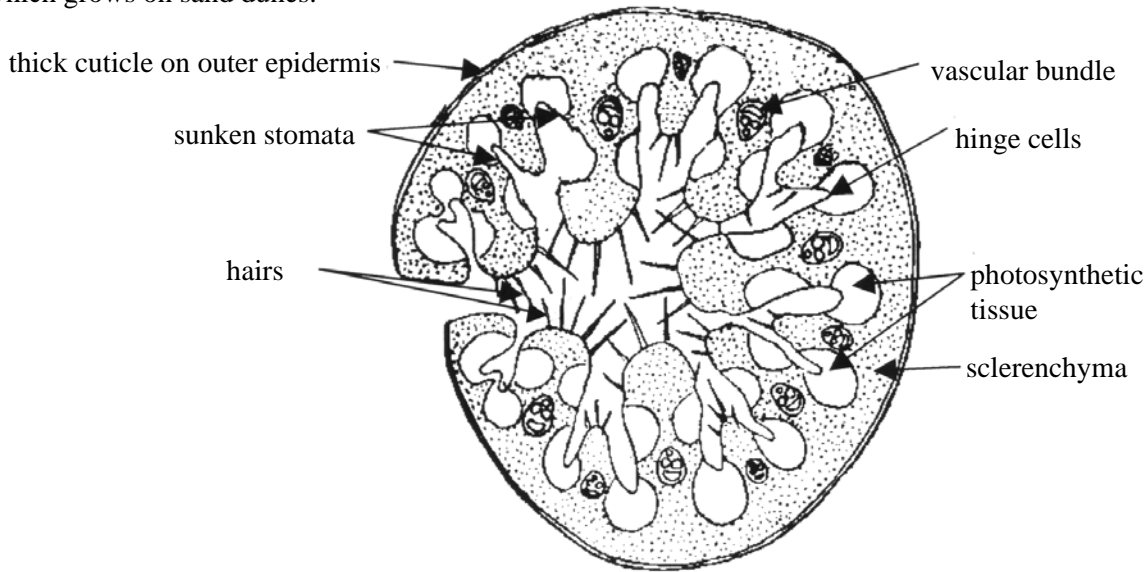
(ii) State two xerophytic adaptations of Sorghum.

1. ....

2. ....

[2]

The diagram shows a section through the leaf of the xerophytic plant, Marram grass (*Ammophila arenaria*) which grows on sand dunes.



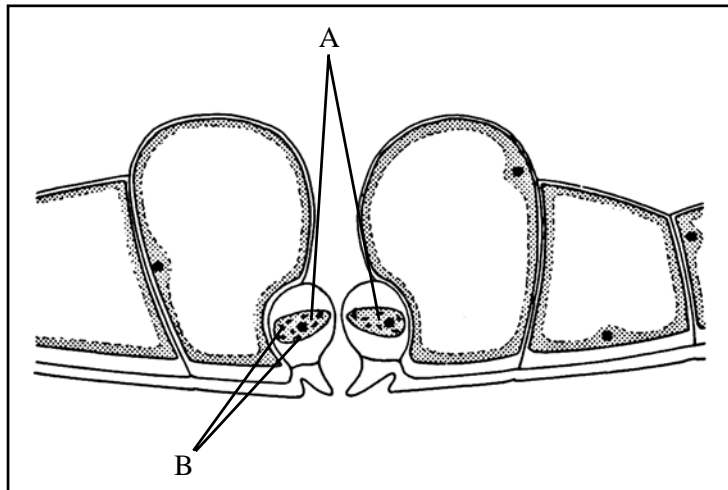
(a) Define the term xerophyte.

.....  
..... [1]

(b) State and explain the xerophytic features shown by *Ammophila*.

.....  
.....  
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.....  
..... [5]

The diagram shows details of the cells in the lower (abaxial) surface of a holly leaf.



(a) Name :

(i) Cells A.

..... [1]

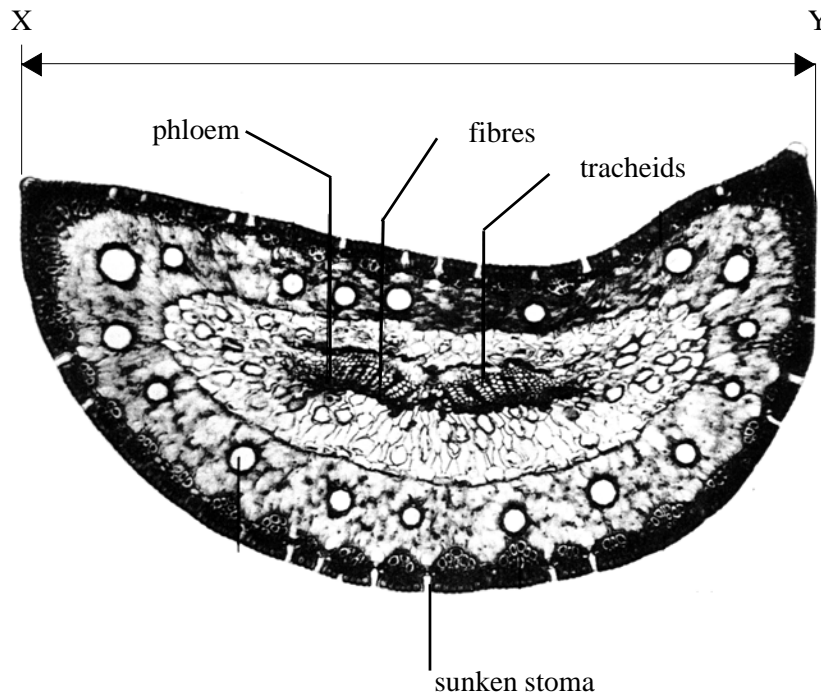
(ii) Organelles B.

..... [1]

(b) Explain why the arrangement of cells shown may be described as a xerophytic adaptation.

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.....  
.....  
.....  
..... [3]

The diagram shows a transverse section through a needle of the Scots pine tree (*Pinus sylvestris*).



(a) The magnification of the leaf was x 120. Calculate the maximum width of the needle between X-Y.

Answer ..... [2]

(b) Outline the significance of each of the following features:

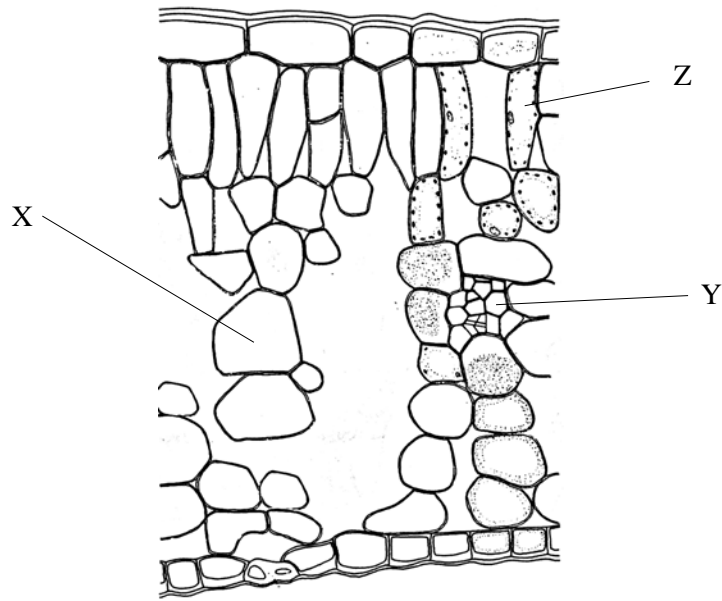
(i) Sunken stomata.

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.....  
.....  
..... [3]

(ii) The presence of tracheids as the main water-conducting elements.

.....  
.....  
.....  
..... [2]

The diagram shows a vertical section through part of a plant organ.



(a) Identify the organ.

..... [1]

(b) Using the letters, X, Y and Z, identify each of the following types of cell.

X: ..... [1]

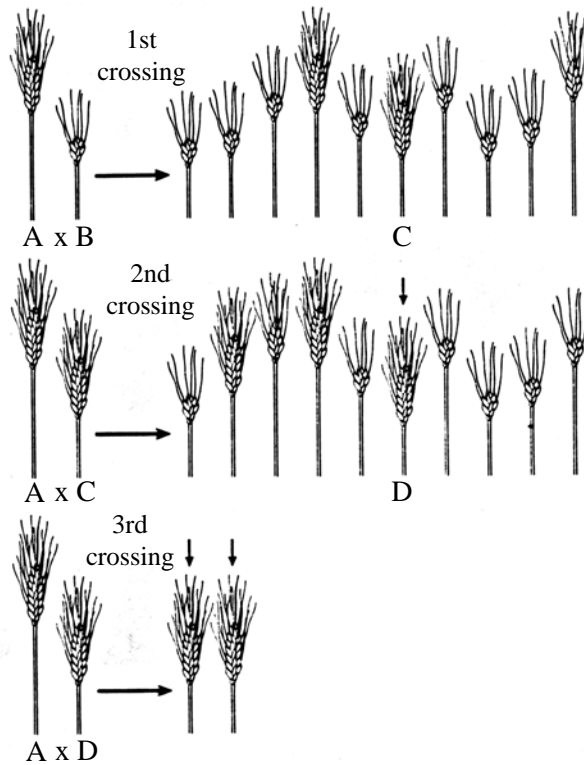
Y: ..... [1]

Z: ..... [1]

(c) Explain the significance of the vertical orientation and shape of cells in layer Z.

.....  
.....  
..... [2]

Study the diagram below which shows the principle of backcrossing in wheat. The aim of the crosses was to introduce the gene for shortness from strain B into high-yielding strain A.



(a) Suggest why shortness is considered a useful trait in wheat.

.....  
 ..... [2]

(b) Explain why:

(i) C was chosen after the first cross.

..... [1]

(ii) C was allowed to self fertilise before being crossed with A.

..... [1]

(iii) The conservation of wild strains of wheat is considered important.

.....  
 .....  
 ..... [2]

Domestication of plants has resulted in significant differences between modern cultivated strains and their wild ancestors. The table below summarises some of the differences:

Characteristic	Wild Strain	Domesticated Strain	Example
Dispersal mechanism	Very efficient	Poor	Wheat
Seed dormancy	Well developed	Lost	Sweet potato
Size of storage organ	Small	Large	Carrot
Growth habit	Perennial	Annual	Rice

(a) Suggest why:

(i) plant breeders have attempted to reduce the efficiency of wild strains' dispersal mechanisms.

.....  
 .....  
 ..... [2]

(ii) the seeds of wild strains usually remain dormant for a period.

.....  
 .....  
 ..... [3]

(b) Outline the potential evolutionary significance of moving plants from their natural region to a new area.

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 .....  
 ..... [2]

In the 1950's, in the Philippines, a major rice breeding programme was started. One of the crosses was between a semi-dwarf strain of Japonica rice known as Dee-geo-woo-gen and Peta, a high-yielding drought-resistant but tall-stemmed variety. The offspring of this cross were named IR-8 and were high-yielding, early maturing, semi-dwarf and insensitive to photoperiod (day length).

(a) Suggest why each of the following traits are considered to be a useful characteristic in rice varieties.

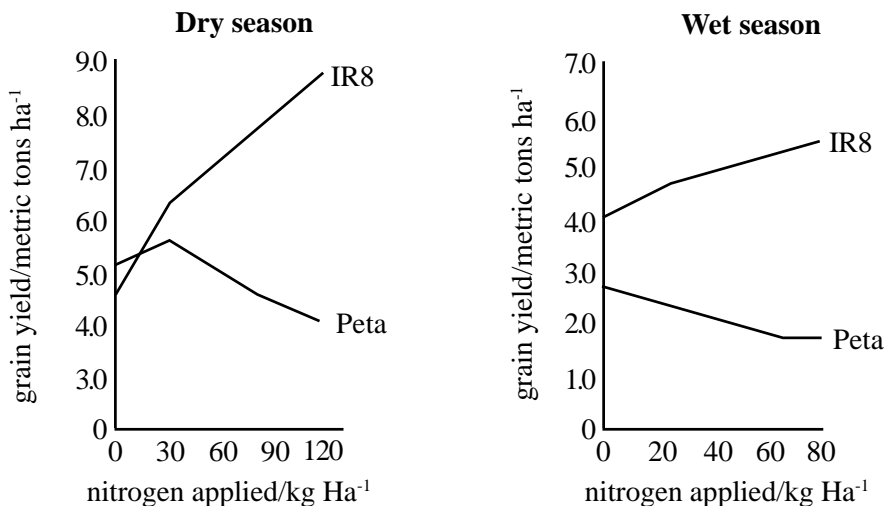
(i) semi-dwarf growth habit.

.....  
 ..... [1]

(ii) insensitivity to photoperiod.

.....  
 ..... [1]

The graphs show the effect of nitrogen application in the grain yield of Peta and IR-8 during the dry and wet season.



(b) Suggest an explanation for the relationship between grain yield and nitrogen application in:

(i) IR-8 in the dry season.

.....  
 ..... [2]

(ii) Peta in the dry season.

.....  
 ..... [2]

(iii) IR-8 in the wet season.

.....  
 ..... [2]



The table summarises the efficiency of water use of important crops.

Crop	Water use efficiency/ kg H <sub>2</sub> O used kg <sup>-1</sup> dry matter produced
Sorghum	295
Maize	340
Wheat	550
Soy beans	650
Alfalfa	350

Sorghum and Maize are C4 plants. C4 plants have very high carbon dioxide affinities and can effectively ‘store’ carbon dioxide in specialised cells. This reduces their need to maintain open stomata.

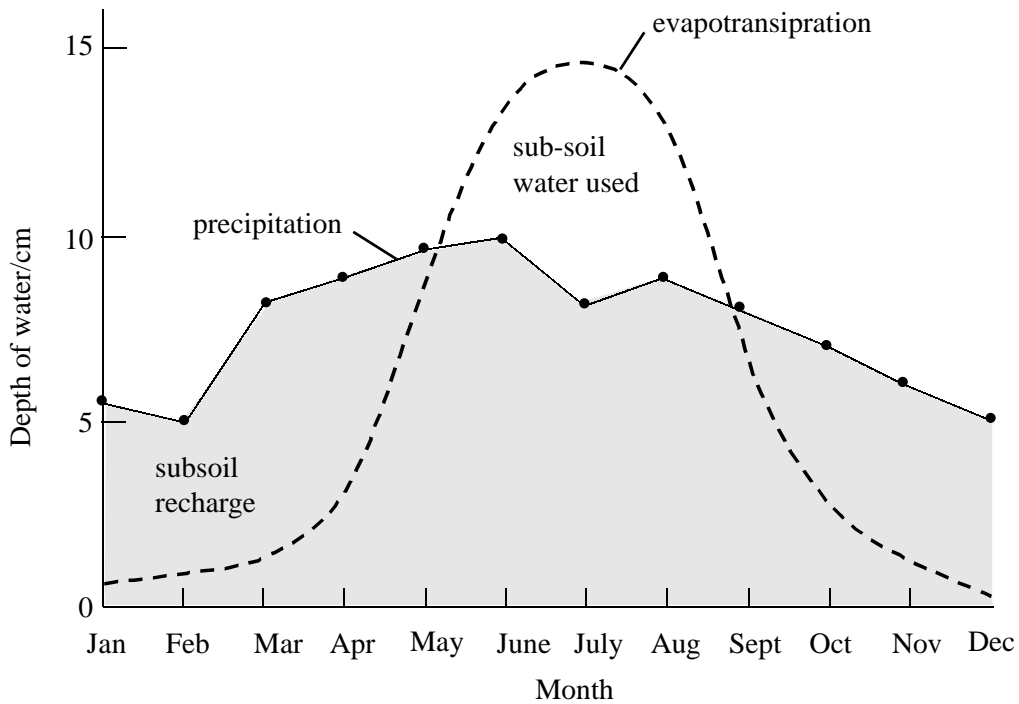
(a) Suggest why C4 plants have high water use efficiency.

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.....  
..... [3]

(b) Explain why adequate soil moisture is essential for healthy crop production.

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.....  
.....  
.....  
..... [4]

The graph shows the pattern of precipitation and evapotranspiration over a field of corn in the United States.



(a) State the period over which there is a water deficit.

.....  
 ..... [1]

(b) Explain what effect this deficit would have on crop productivity.

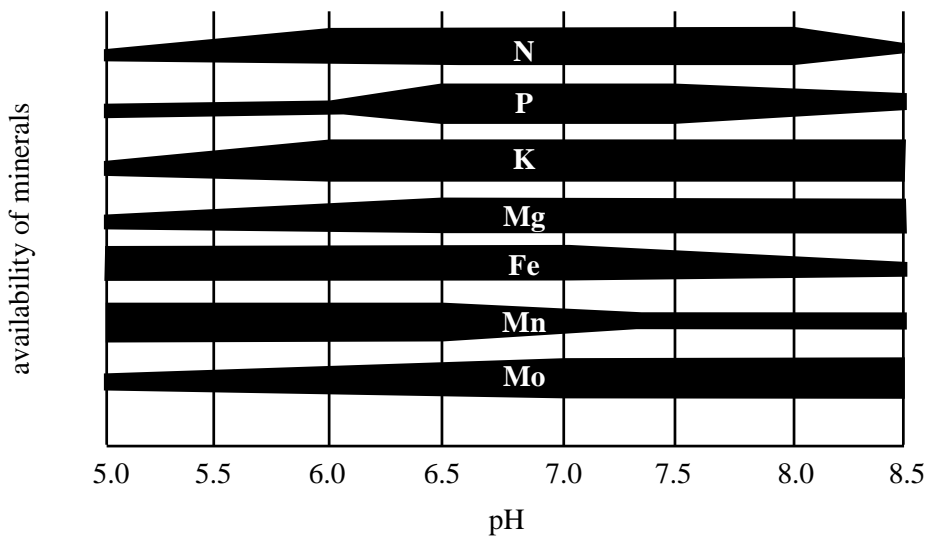
.....  
 .....  
 ..... [3]

(c) Suggest why planting crops at high densities may reduce the harmful effects of water shortage.

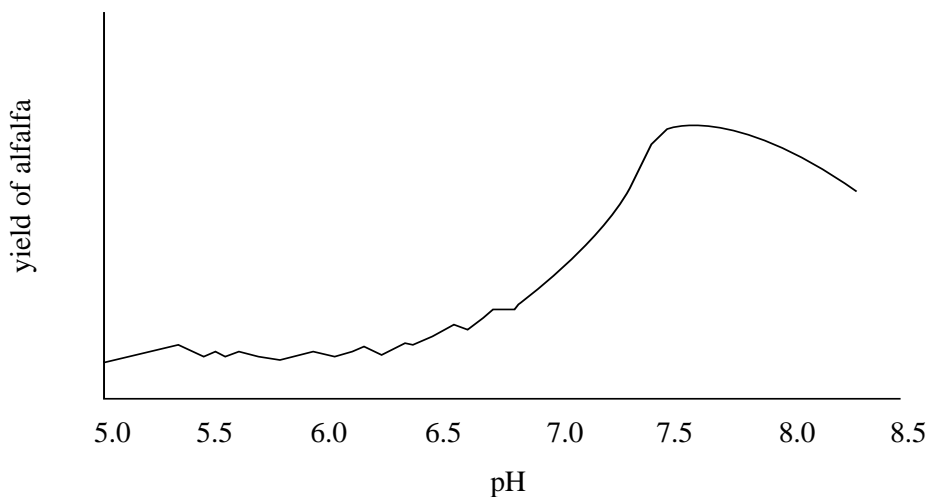
.....  
 .....  
 .....  
 ..... [3]

Graph 1 shows the effect of soil pH on the availability of minerals to crops. Graph 2 shows the effect of soil pH on the yield of alfalfa.

Graph 1



Graph 2



(a) Explain why a farmer might choose to lime a field of soil pH 5.6 before growing alfalfa.

.....  
 ..... [2]

The farmer practices crop rotation and in the following year intends to plant corn in the field.. Corn has a requirement for plentiful supplies of certain micronutrients including manganese (Mn) and iron (Fe).

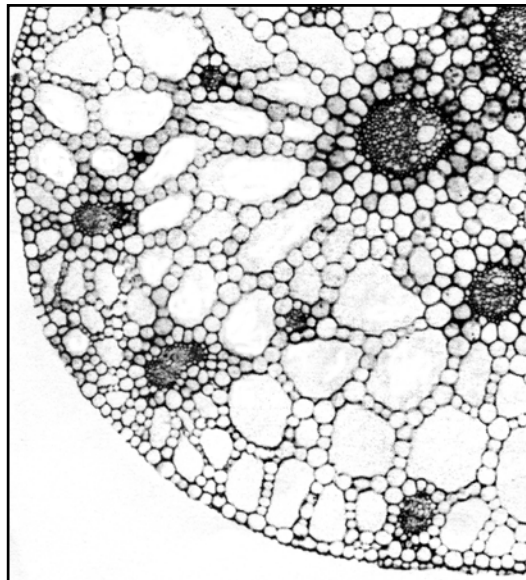
(b) Explain why the corn may show symptoms of mineral deficiency if planted in the field.

.....  
 .....  
 ..... [3]

(c) State the pH range over which phosphorus is most available.

.....  
 ..... [1]

The diagram shows a part of a transverse section through the stem of Broadleaved Pondweed (Potamogeton nutans).



State and explain the significance of three features of this stem which are typical of plants which are found in aquatic environments.

Feature 1. .... [1]

Significance. ....

..... [2]

Feature 2. .... [1]

Significance. ....

..... [2]

Feature 3. .... [1]

Significance. ....

..... [2]