This unit is primarily about **soils**;

- where and how they form
- what types of soil there are
- what grows in them.

There is also a section about how a soil develops on a barren piece of land, in this case from **sand dunes**.

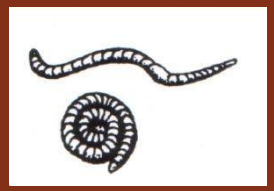
Soil is part of our environment which is usually taken for granted! It is not an obviously interesting substance.

However soil research reveals the processes operating at this thin boundary between the living and the dead parts of our planet.

Here are some soil organisms

We know that terrestrial life depends on the soil, but soil development also depends on the existence of life.

Soil is one of the Earth's great 'bio-feedback' mechanisms, like the atmosphere and the oceans.



Mineral matter is the product of weathering and comes from rocks.

Air in the soil carries gases to and from the plant roots and animals. It is in the pore-spaces when water is not.

SOIL IS MADE UP OF FOUR COMPONENTS

Water is held in the pore-spaces and carries dissolved salts- plant food

inorganic

Organic matter is the largest fraction. It comes from plant and animal remains that are gradually broken down into a brown material called humus. It is the major source of the three main plant foods- nitrogen, sulphur and phosphorus. It holds water, improves soil structure and provides the energy for plant (and animal) growth.

organic

Studies of soils have shown that the development of a soil is controlled by five major factors:

CLIMATE; especially temperature and precipitation

LIVING ORGANISMS; from vegetation to humans

RELIEF; height and slopes are crucial

PARENT MATERIAL; formed from the bedrock

TIME; absolutely essential! (rate of weathering or decomposition)

Q. Describe and explain the factors that determine soil development. (10)

Typical question

How will you earn your 10 marks?

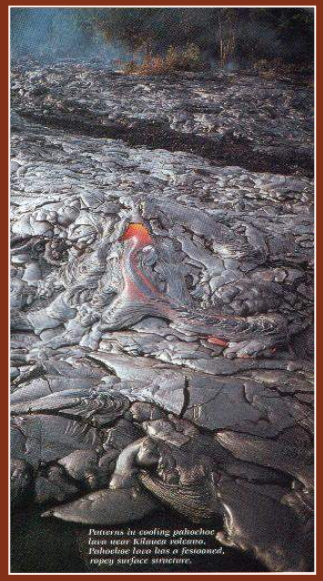
What 5 factors will you write about?

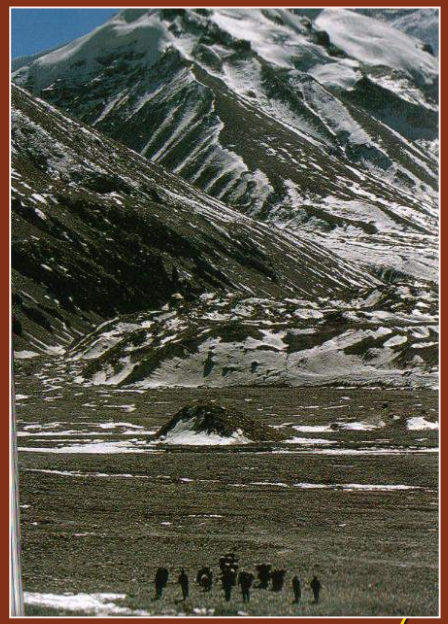
<u>Naming</u> each will only get you half marks- how will you get the rest?

Try doing this without looking in your booklet first!

SOIL CREATION

As soon as a barren surface like a lava flow, glacial outwash plain or a beach begins to be colonised by flora and fauna, soil development is said to have begun.





There are many different types of soils around the world. Copy these definitions down:

ZONAL SOILS are widespread and well developed in various biomes, e.g. deciduous or coniferous woodland.

INTRAZONAL SOILS are more localised, less well developed and depend on local factors such as patent material and drainage.

AZONAL SOILS are very young and not developed from the barren area, such as glacial or alluvial deposits.

We only need to know about three of these!

Going up or going down?

Think about these questions;-

1. If the temperatures are high in an area, what is likely to happen to the water in the topmost layers of the soil?

Evaporation will cause capillary action; water (with salts dissolved in it, remember) will rise towards the surface .

The result of this is that there will be a crusty layer of salt minerals left behind on the surface.

This type of soil is classed as a PEDOCAL as calcium salt is commonly present in the deposits.

This soil can be good for plants if it can be watered enough.

2. If the precipitation is high in an area, what is likely to happen to the water in the topmost layers of the soil?

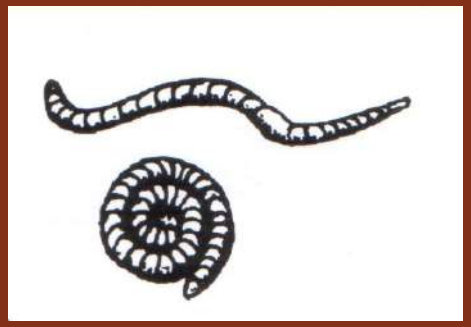
Infiltration will cause leaching action; water (with minerals dissolved in it, remember) will descend towards the bedrock.

The result of this is that there will be a hard-pan layer of minerals leached to a layer below the surface.

This type of soil is classed as a PEDALFER as aluminium and iron are commonly present in the deposits.

This soil can be bad for plants as minerals are too deep for plants to access.

Organic debris decays and is mixed with the inorganic mineral matter by living organisms.



+

The amount of mixing varies with depth, and this creates layers called horizons. The whole vertical section is called a profile.

Ao Horizon

Leaf litter- the un-decomposed plant material lying on the surface. Food for biota like worms.

Fermentation layer- the first stages of rotting takes place. Leaf shape can still be seen.

Humus layer- well-rotted material now available to plants as food.

A Horizon- topsoil, rich in nutrients and aerated by earthworms

B Horizon- subsoil, coarser with less organic material and contains leached minerals

C Horizon- regolith (broken up parent material) sit on the underlying bedrock

Eluviation is where the minerals get dissolved into the water in the pore spaces. This takes them from the layer they started in, called leaching.

Illuviation is where they get re- precipitated back out into the soil as visible minerals. This adds them to a layer that they don't normally get to, creating an iron pan.

Mor humus is associated with coniferous forest or moorland, in wet, cool areas with acidic parent material.

Mull humus is associated with deciduous woodland and is well-aerated with no clear humus layer.

CASE STUDY SOIL TYPES.

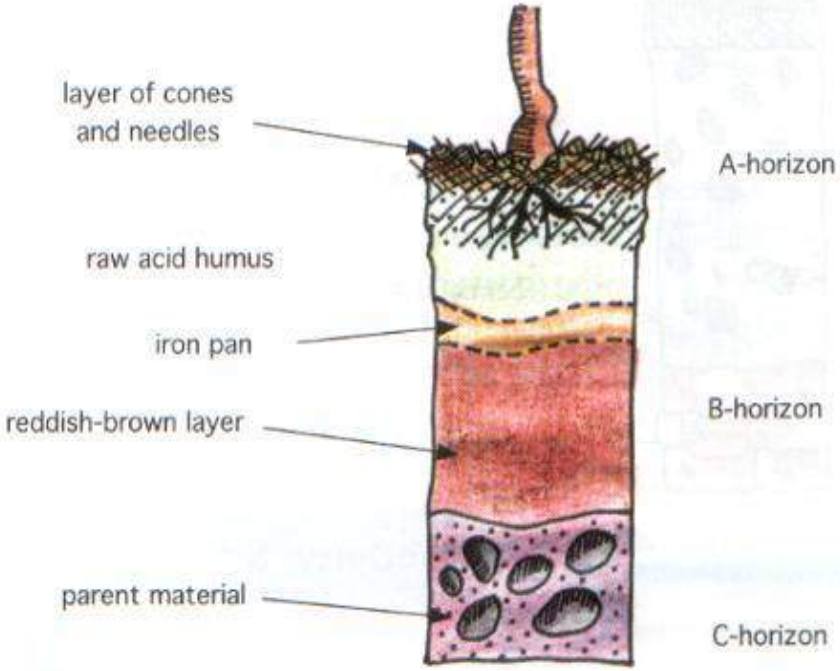
We need to study three soil types at Higher- all three are pedalfers.

You will need to be able to sketch the profile of any or all three of them, and describe their characteristics and what factors were important in creating them.

When describing a soil, its colour, texture and horizon definition must be described and explained!

1. Podsols. (podzols)

- These are soils of a cool, wettish climate.
- They often are found on upper slopes rather than flat land.
- They develop best under vegetation that causes acidic (MOR) conditions- like coniferous trees.
- They have a well-developed hardpan of iron and aluminium.
- Their upper layers are quite badly leached, limiting plant growth to un-demanding types.
- They have a clearly developed set of horizons.
- They lack a lot of soil organisms.



PODZOLS

Podzol soils are infertile soils which are found in northern latitudes under coniferous forests. Cones and needles from the coniferous trees help to form a very acidic humus.

Melting snow in Spring releases water which causes heavy leaching – nutrients are removed from the topsoil leaving a very sterile soil. The leaching of iron and aluminium oxides results in the formation of an iron or hard pan at the top of the B-Horizon. This can impede drainage and result in waterlogging in the A-Horizon.

The low rainfall and low temperatures restrict the actions of soil organisms such as worms which, if present, will help to break down the soil and improve its composition.

The fertility of the soil can be improved by drainage and adding lime (to make it less acidic) but podzols are of limited value for farming and only the hardiest of crops, such as potatoes and oats, can be grown.

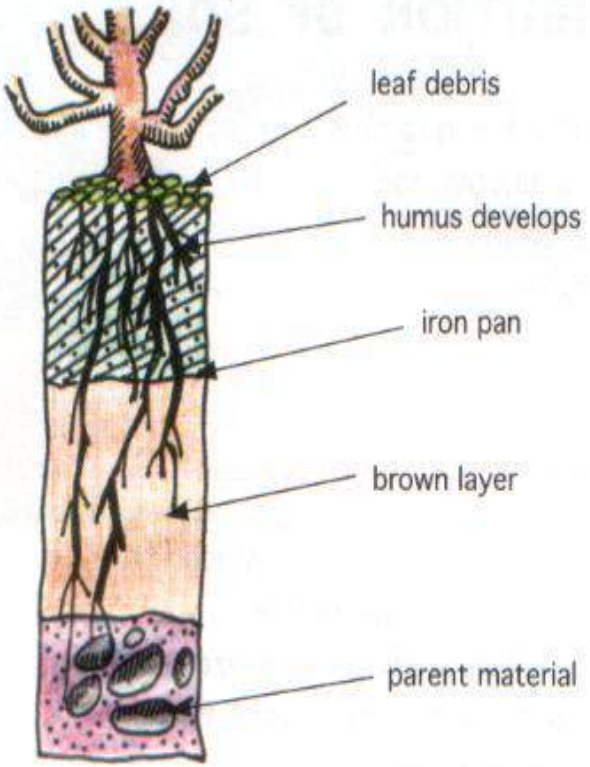
2.Brown Forest. (Grey-Brown Earth)

- These are soils of a milder, wettish climate.
- They often are found on gentle slopes rather than flat land.
- They develop best under vegetation that causes less acidic (MULL) conditions- like deciduous trees.
- They may have a slightly-developed hardpan of iron and aluminium.
- Their upper layers are slightly leached.
- They have a poorly developed set of horizons.
- They have quite a lot of soil organisms.

BROWN EARTH SOILS

Brown Earth soils are fertile soils which are useful for agriculture. They are found in temperate latitudes under the natural vegetation cover of deciduous trees. The leaves which fall from the deciduous trees return nutrients to the soil. Large areas of these trees have, however, been cleared away to make way for farming and settlement.

The milder climate encourages decomposition and the formation of a richer humus. Organisms such as earthworms and rodents help to mix the soil. The presence of a variety of plants adds nutrients to the topsoil and helps to make the soil more fertile. Precipitation is greater than evaporation and gradual leaching occurs – this may result in some soils becoming waterlogged. Iron pans might develop where more rapid leaching occurs. A wide range of crops, including wheat and barley, can be grown on Brown Earth soils.



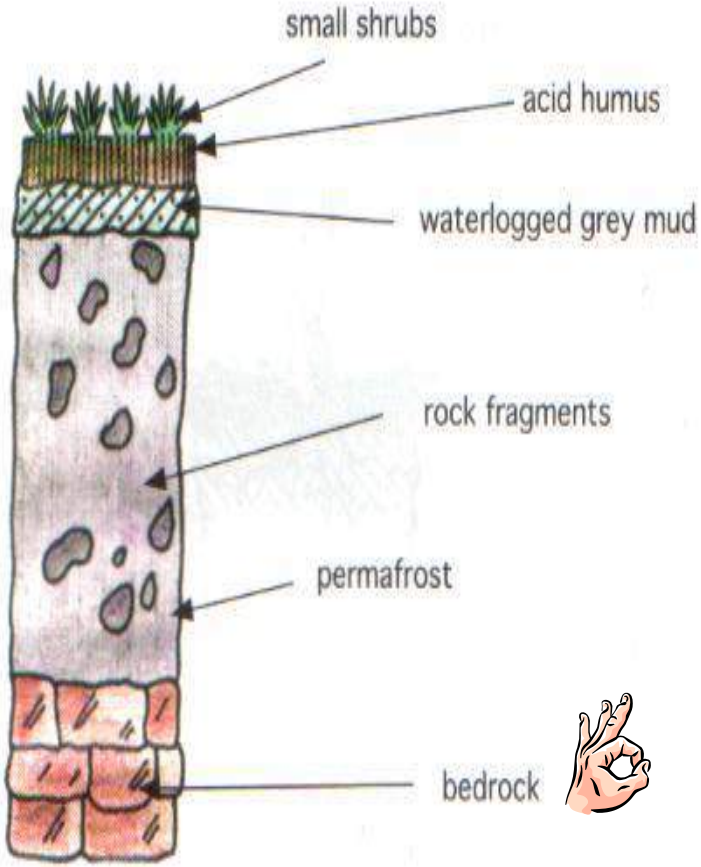
Brown Earth soil in the making

3. Gley. (Tundra- gley)

- These are soils of a very cold, wet climate.
- They often are found on flat land.
- They develop serious waterlogging that starves soil of oxygen; few plants can grow.
- They develop an extreme form of MOR (acid) humus.
- Their upper layers are blue-grey in colour.
- They have a poorly developed set of horizons.
- They have virtually no soil organisms.
- In extreme areas of the tundra, permafrost exists.

GLEY SOILS

Gley soils are infertile soils found in the colder parts of the world (high latitudes and high altitudes). Gley soils become waterlogged when the frozen subsoil melts at the end of winter. Waterlogged or gley soils are deficient in oxygen and contain few organisms to mix and improve the soil. The seasonal freezing and thawing of the soil prevents the development of clearly-defined horizons. Gley soils are virtually useless for arable farming.



Gley soil in the making

	A	B	C	D
1		TUNDRA GLEY	PODSOL	BROWN EARTH / FOREST
2	temperature			
3	precipitation			
4	slope of land			
5	height			
6	how developed an iron pan?			
7	number of soil organisms			
8	drainage quality			
9	how defined horizons?			
10	degree of leaching			
11	vegetation			
12	PH and name of humus			
13	fertility			
14	texture	heavy clay	more crumbly	heavy and sticky, lumpy
15	colours- name horizon			

Copy this table into a whole page of your jotter

Note- mixed up!

Can you sort them out?

Go back through the last six slides, armed with the copy of the table.

Fill in the boxes on your copy of the table w
keywords/phrases to summarise each type.

These points will emphasise the important parts of the three soil types. You will do well to learn them thoroughly

Sample answer

		B	C	D
		TUNDRA GLEY	PODSOL	BROWN EARTH / FOREST
2	temperature	cold	cool	mild
3	precipitation	wet	Quite wet	Not very wet
4	slope of land	flat	undulating	Sloping gently
5	height	Any- best low	higher	middling
6	how developed an iron pan?	none	well	Not marked
7	number of soil organisms	none	few	many
8	drainage quality	V.poor	poor	better
9	how defined horizons?	badly	good	poor
10	degree of leaching	total	badly	little
11	vegetation	little	Pine trees	deciduous
12	PH and name of humus	V.acid	acid	Less acid
13	fertility	none	low	higher
14	texture	Heavy sticky lumpy	Heavy clay	More crumbly
15	colours- name horizon	Blue grey A	Red brown B	Light brown B

Choose one of the three soil types and explain the influence of the soil-forming factors in its formation. (10)

Typical question

How are you going to earn the ten marks?

How do you choose which soil to 'do'?

Notice that this asks you to <u>EXPLAIN.</u>

Try another question……..

Draw a soil profile of the main characteristics of the given soil type. (8)

Typical question

What do you need to label in such a question?

What makes this soil different from the others? Label <u>these</u> features.

There are sample answers to these questions on the Prepwork folder.

BIOSPHERE QUESTIONS PART 1.

1. Name the four components of a soil; which is the most important?
2. Name the five factors that contribute to soil development.
3. Define HORIZON and SOIL PROFILE.
4. Describe the difference in water flow between a pedalfer and a pedocal.
5. Explain which order these come in; illuviation and eluviation.

6. Which of our three case study soils –

- is found in the coldest temperatures.
- has the worst-defined horizons.
- has the most biota.
- has the least acid soil.
- has the worst decomposition rate.
- is found on neither flat nor very steep land.
- has the best- developed hard pan.
- has the least oxygen.

7. What is the difference between Mull and Mor soil?

Now watch the <u>second</u> half of the video 113; this deals with the soils you have learned about in this section.

end of part 1

DO NOT ANSWER THIS QUESTION IF YOU HAVE ALREADY ANSWERED QUESTION 5

2006

Question 6: Biosphere

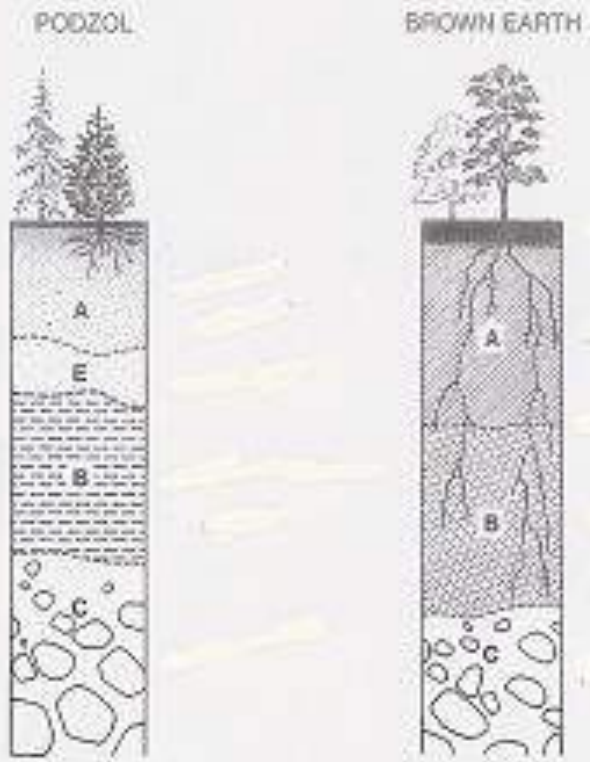
Study Reference Diagram Q6 which shows soil profiles for a podzol and a brown earth.

(a) **Describe** the different properties (horizons, colour, texture, drainage) of the two soils shown.

(b) **Explain** the differences in their formation.

14

Reference Diagram Q6 (Selected soil profiles)



1998

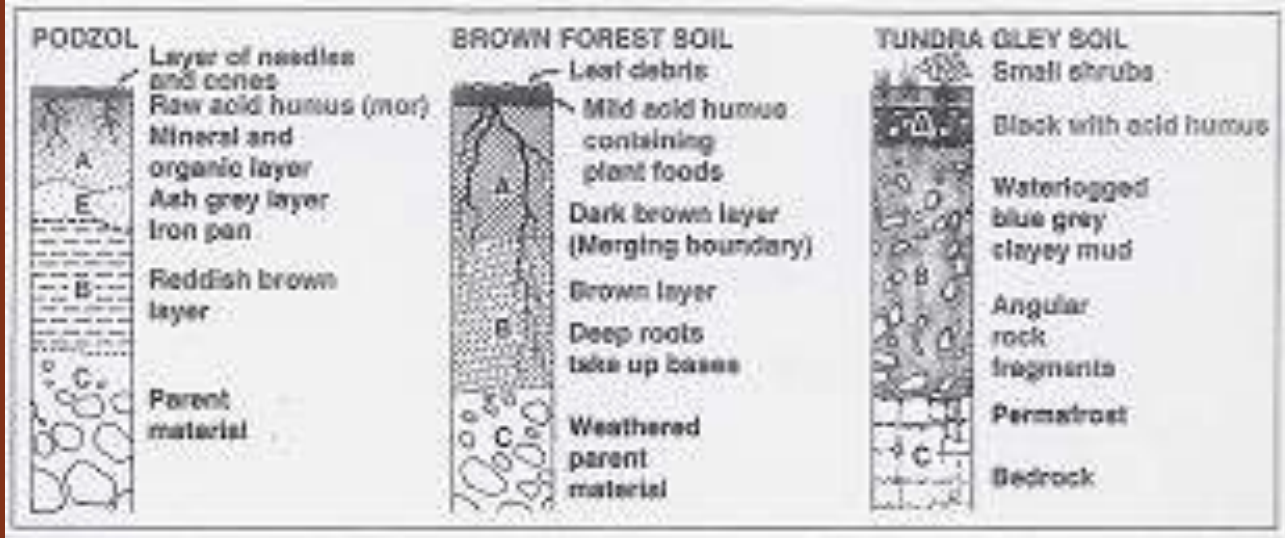
Question 4

Marks

(a) Study Reference Diagram Q4, which shows three different soil profiles.
Choose one of the three soil types and, with the aid of the reference diagram provided, describe and explain the processes which have contributed to its formation. 10

(b) Describe and account for the likely plant successions in
~~either (i)~~ a coastal sand dune belt
~~or (ii) an area of derelict or abandoned land.~~
Your answer should make reference to specific plants. 10

Reference Diagram Q4 (Selected soil profiles)



Question 4

2002

Study Reference Diagram Q4.

Select **one** of the following soil types:

(i) gley;

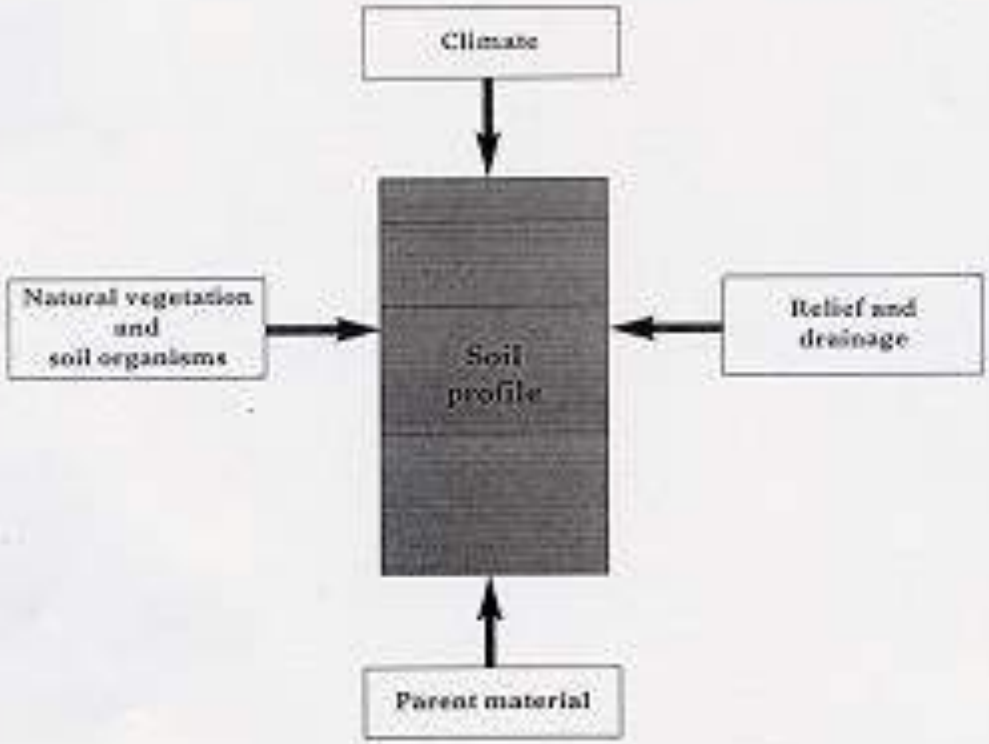
(ii) podsol;

(iii) brown earth.

With the aid of an annotated sketch of a soil profile, **explain how** the major soil forming factors shown in the diagram have contributed to its formation.

~ 12

Reference Diagram Q4 (Main factors affecting soil formation)



Question 4 1999 Marks

(a) Study Reference Diagram Q4.

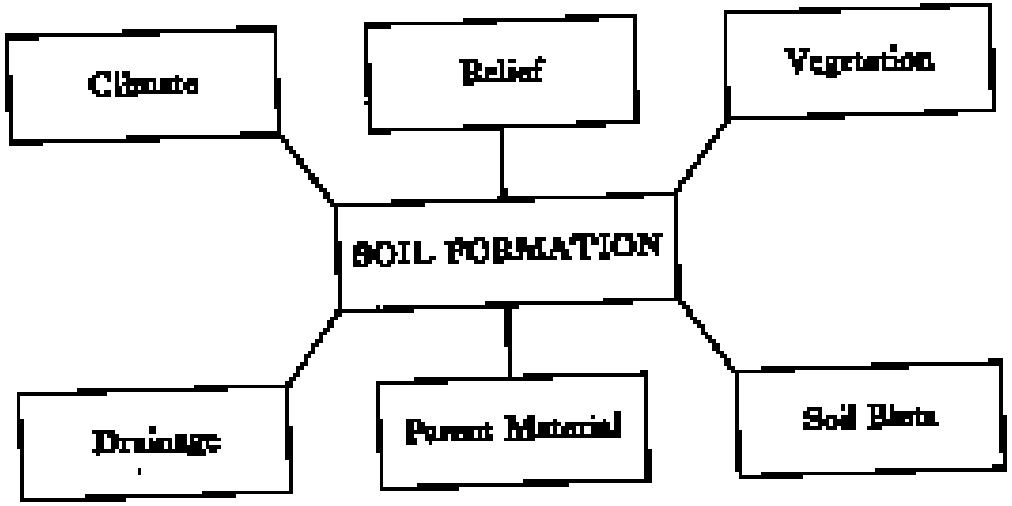
Choose one of the following soil types:

(i) podzol
(ii) brown forest soil
(iii) gley,

and describe the influence of the various soil forming factors on its formation. 10

(b) Explain fully what is meant by the term "climax vegetation". 6

Reference Diagram Q4 (Physical factors affecting soil formation)



2004

Marks

Question 4

Choose one of the following soil types:

- podzol;
- brown forest soil;
- gley.

(a) Draw a soil profile and annotate it to show the main characteristics of the soil.

(b) Explain the processes which have created this soil profile. 4 / 2

[Turn over

2007

Marks

DO NOT ANSWER THIS QUESTION IF YOU HAVE ALREADY ANSWERED QUESTION 5

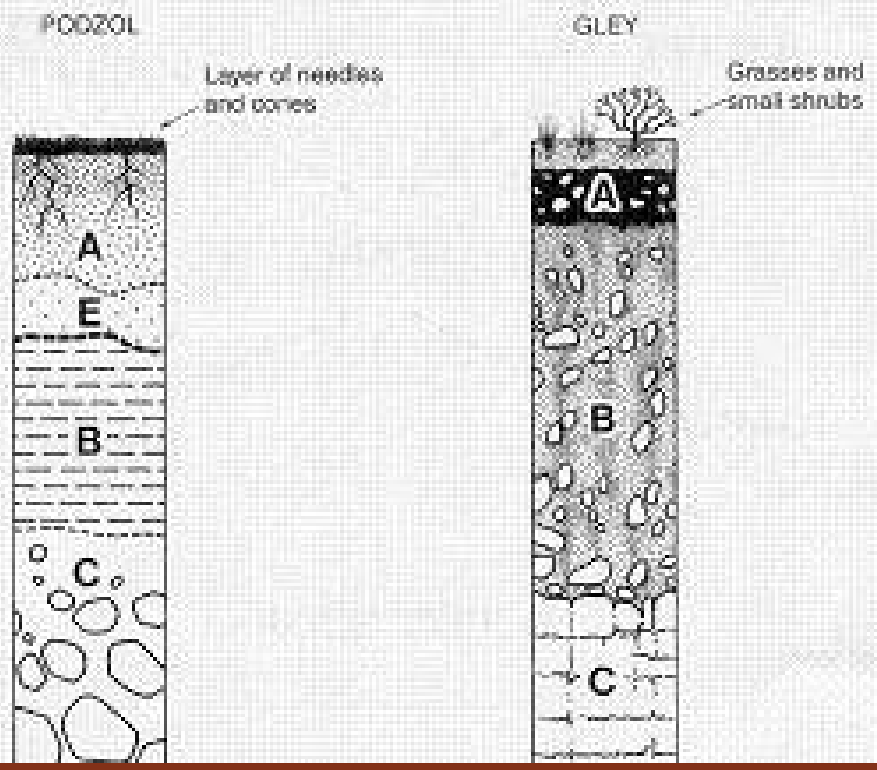
Question 8: Biosphere

Study Reference Diagram Q6A which shows two soil profiles.

Choose **one** of the soil profiles.

(i) **Describe** the characteristics of the soil, including horizons, colour, texture and drainage. 6

Reference Diagram Q6A (Selected soil profiles)



Part 1

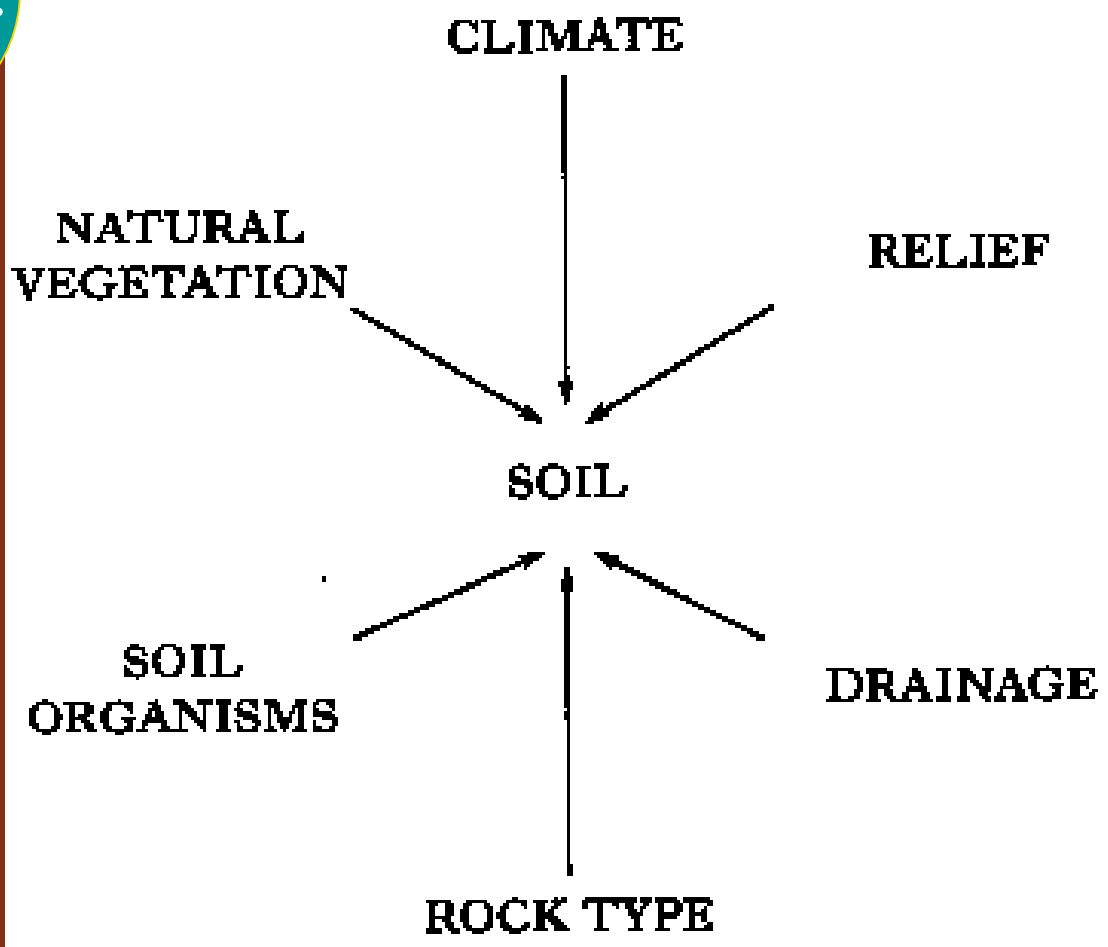
Part 2

Question 6 (continued)

(ii) Study Reference Diagram Q6B.

Explain how the major soil forming factors shown in the diagram have contributed to the formation of your chosen soil profile. # 8

Reference Diagram Q6B (Main factors affecting soil formation)



PODZOLS

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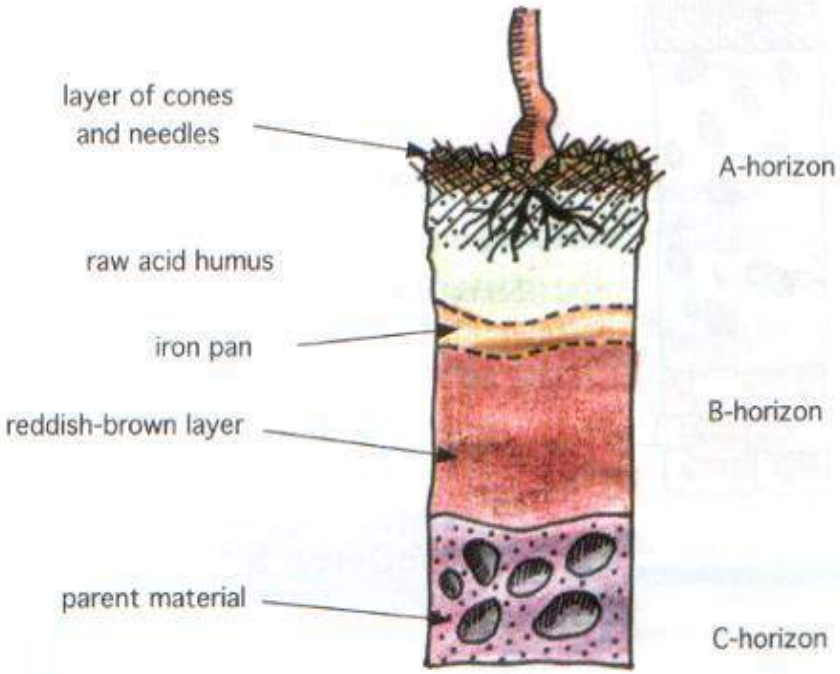
Melting snow in Spring releases water which causes heavy leaching – nutrients are removed from the topsoil leaving a very sterile soil. The leaching of iron and aluminium oxides results in the formation of an iron or hard pan at the top of the B-Horizon. This can impede drainage and result in waterlogging in the A-Horizon.

The low rainfall and low temperatures restrict the actions of soil organisms such as worms which, if present, will help to break down the soil and improve its composition.

The fertility of the soil can be improved by drainage and adding lime (to make it less acidic) but podzols are of limited value for farming and only the hardiest of crops, such as potatoes and oats, can be grown.

the soil profile of a podzol



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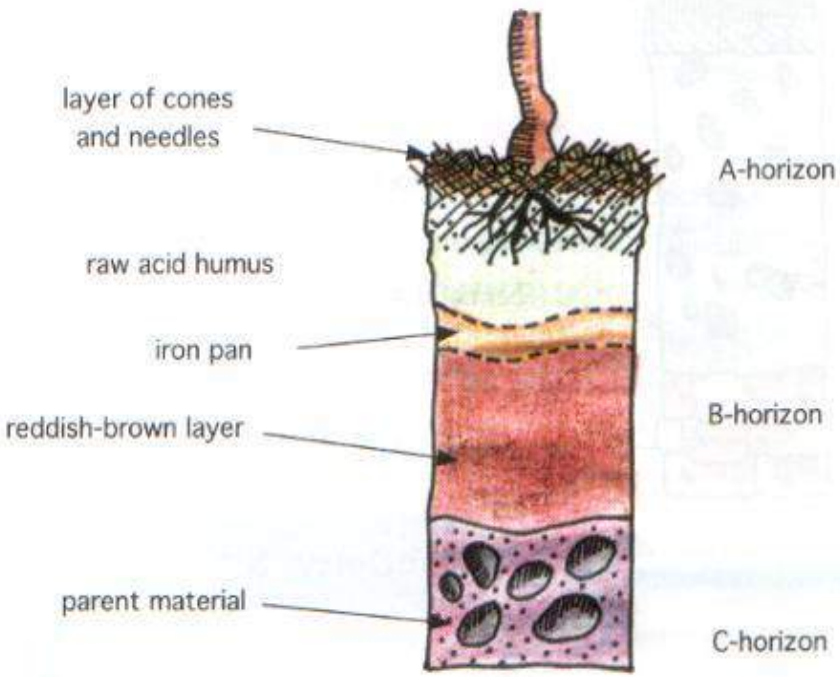

BROWN EARTH SOILS

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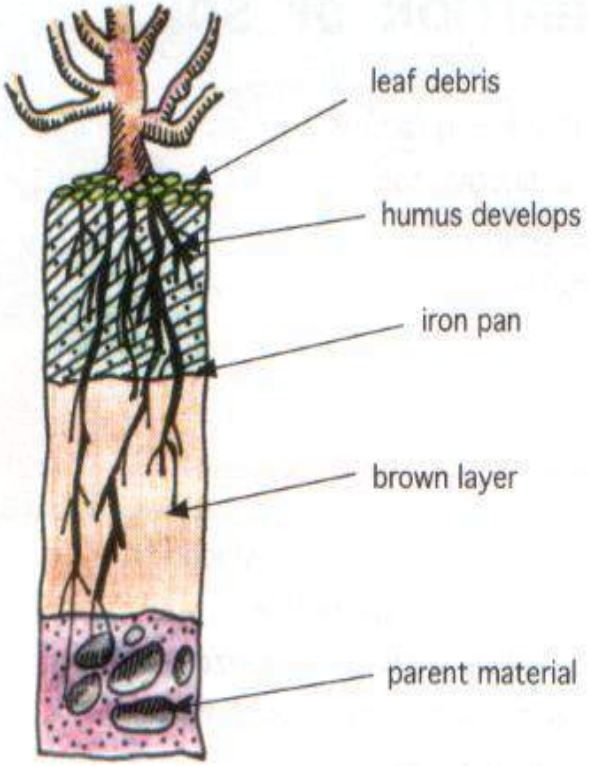
The milder climate encourages decomposition and the formation of a richer humus. Organisms such as earthworms and rodents help to mix the soil. The presence of a variety of plants adds nutrients to the topsoil and helps to make the soil more fertile. Precipitation is greater than evaporation and gradual leaching occurs – this may result in some soils becoming waterlogged. Iron pans might develop where more rapid leaching occurs. A wide range of crops, including wheat and barley, can be grown on Brown Earth soils.



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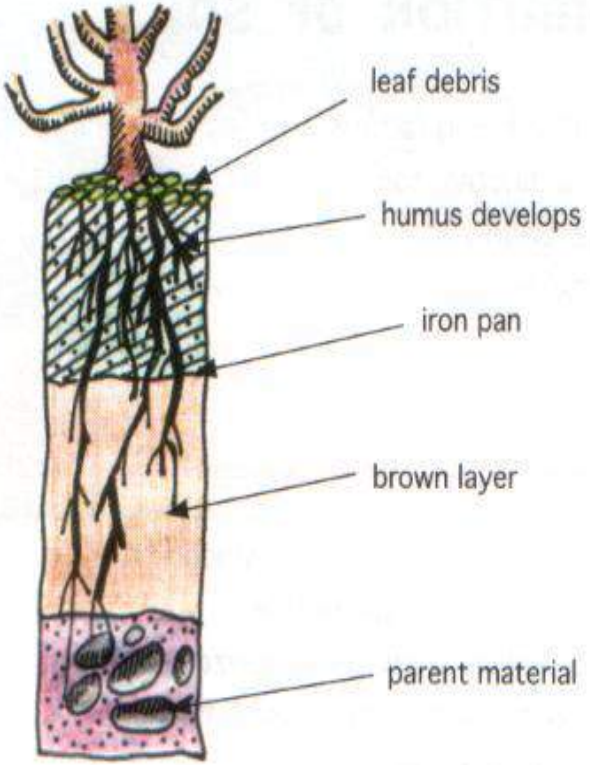

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GLEY SOILS

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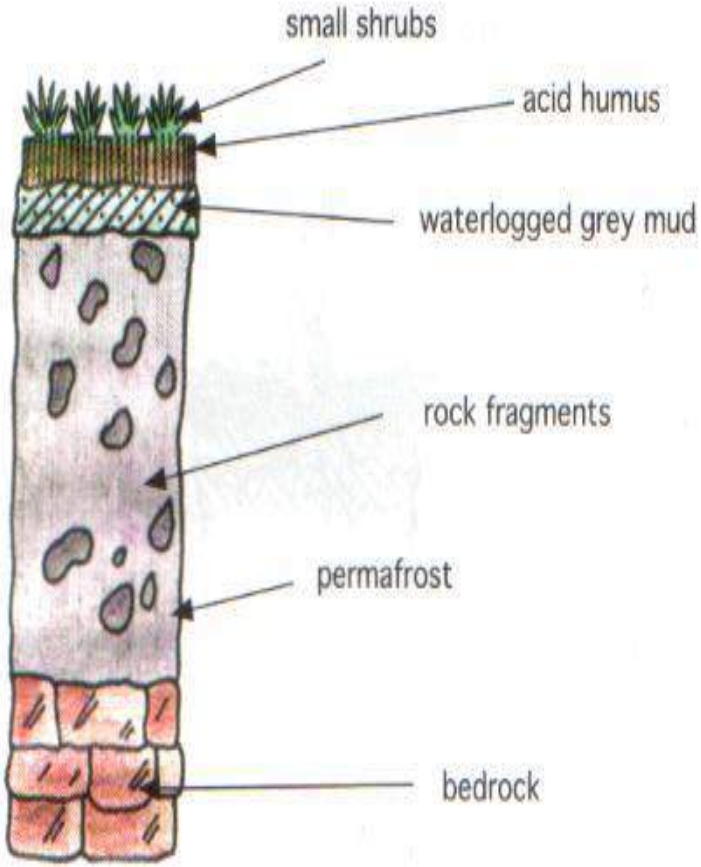

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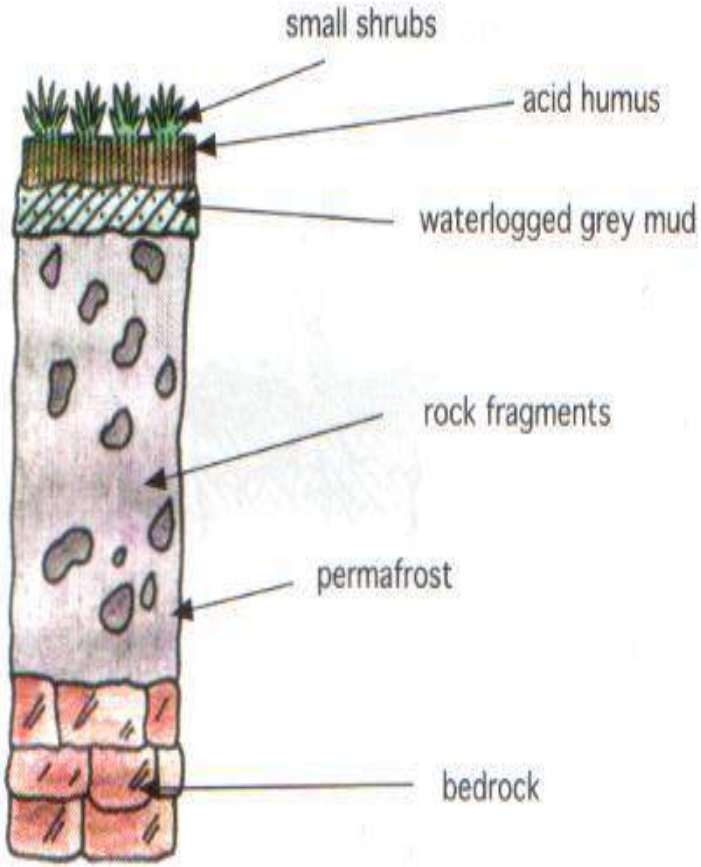

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