

Via Afrika Geography

Grade 10 Study Guide

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Our Teachers. Our Future.



Study Guide

Geography

Grade 10



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Introduction to our Geography 10 Study Guide eBook

Welcome to the Grade 10 Geography Study Guide. The subject of Geography has changed dramatically over time and it continues to change because it is one of the most dynamic subjects in the curriculum. After all, the Earth and its atmosphere, the home of humankind, is changing all the time and that is what makes our subject so special.

This guide must be used in conjunction with the main textbook, as it is a summary of the main components of the textbook. Geography, like any other subject, does contain facts which must be understood and learnt, but it also emphasizes skills. It is necessary for the learner to analyse and use these facts to understand phenomena and to try to solve problems. Our lives depend on the ways in which we treat our environment and thus, as citizens of the Earth, we must understand the changes that are constantly taking place and our own impact on our surroundings.

Once you have studied the detail in the main textbook, use this guide as a summary. Concentrate on the key concepts and build your knowledge around them. Do this regularly and you will develop into a genuine geographer ready to take your place as a keeper of our vital environment.

Overview

This section introduces you, the learner, to geographic skills and techniques that help you to navigate through topographic maps, aerial photos, orthophoto maps, basic geographical information systems (GIS), atlases and fieldwork, with ease. Each of the units (1-6) present relevant frameworks, graphics, as well as, key concepts and content that provide a steady scaffold for you to build further learning. This section is more practical in nature than the others. It is imperative that you practise all the calculations, measurements and map reading to gain the relevant skills and techniques. You could also expand this practical base by setting your own tasks.



Geographical Information Systems (GIS)

Unit 1 Geographical Information Systems (GIS)

1.1 What is GIS?

- GIS stores geographical data in digital format in a computer.
- Very specific data can be uploaded by a user; for instance, street names, location of a site, specific dates indicating oil pipeline constructions, etcetera.
- GIS can be used by government, industries, land planners, home affairs, public sector offices and private users.
- People are key in developing GIS software that captures important geographic information.
- GIS can help geographers to plan (for instance, where to develop new settlements, dams), where to act (for instance, address high levels of pollutants in a conservation area) and evaluate (for instance, the impact of acid mine drainage on local residents).
- Its use is constantly informed by new data and new technology.
- It provides specific and customised data or information.

1.2 The value of digital information

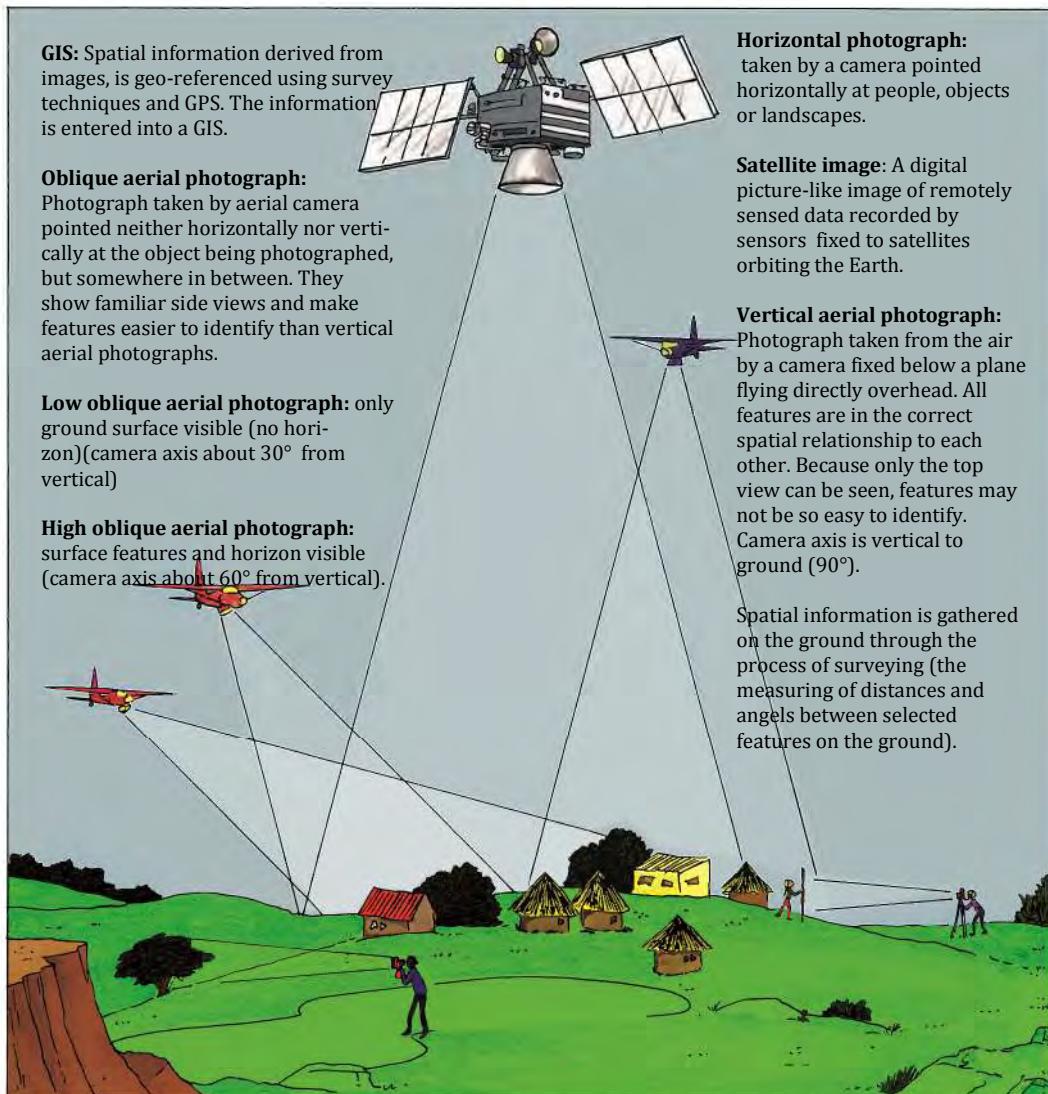
- It can dramatically increase the amount of information that can be collected, stored, analysed and displayed.
- The information is stored in a computer system and manipulated in number form. Every number, letter and colour has a numerical code.
- Information can be selected, sorted and displayed graphically very easily.

Topographic maps

Unit 2 Aerial Photographs

2.1 What are aerial photographic images

Aerial photographic images include aerial photographs, orthophoto maps and satellite images. These are based on photographs taken by either aircraft or satellites.

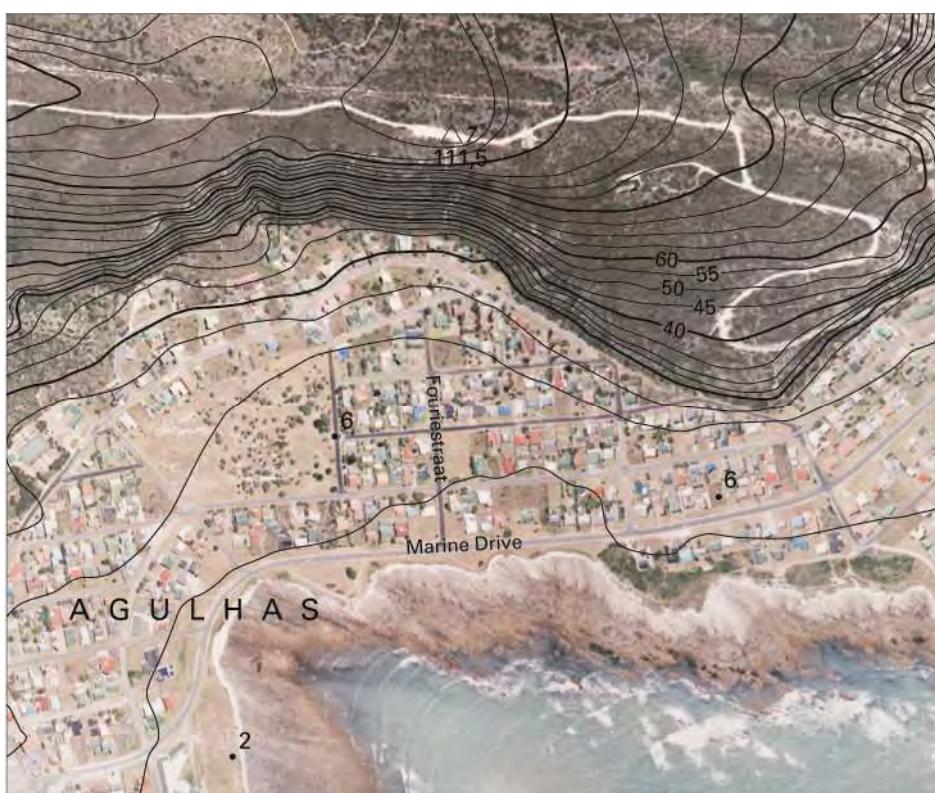


Topographic maps

2.2 Orthophoto maps

2.2.1 Description

- Orthophotos were first made from many vertical aerial photographs that partly covered one another. This was done to create scale corrected images.
- Orthophoto maps are made by adding map information to the orthophotos.
- An orthophoto map is a combination of a map and a photograph, as shown in the image on the next page.
- It has a larger scale (1:10 000) than the topographic map, so features appear larger.
- It is more representative of reality than the topographic map.
- Orthophoto maps can have contour lines superimposed on them to provide a sense of the relief of the landscape. In this way they can provide critical information about where to build or to assess areas most at risk during flooding.



2.2.2 Advantages

- Orthophoto maps have a large scale of 1:10 000 so features can be seen quite easily.
- Orthophoto mapping is quick and easy to use for updating maps.
- Most urban areas and major growth points are covered.

2.2.3 Disadvantages

- Orthophoto mapping is not yet available for the whole of South Africa.
- New full-colour orthophoto images have been made available to the general public only recently, so are difficult to get.

Topographic maps

2.2.4 Developments

- Since 2008, a special camera called a digital mapping camera has been used.
- When this camera is flown over an area, the images are recorded and corrected for scale automatically.

2.3 Satellite images

2.3.1 Description

- Picture-like representation of digital data about the Earth, received from sensors carried on satellites.
- Information collected from the visible and non-visible parts of the spectrum.
- Images are produced that look like photographs but contain more than visible information.



2.3.2 Advantages

- Continuous collection of data for the whole Earth. Changes over time can be watched.
- Can be entered easily into a GIS.
- Data can be looked at in different ways to understand environmental problems.

2.3.3 Disadvantages

- High cost of launching and maintaining orbiting satellites, and managing receiving ground stations.
- Require highly skilled technicians and professionals to make the best use of the information.

2.3.4 Developments

- Developments in satellite imagery closely follow developments in GIS. Early satellite images were not that detailed and could not be used for accurate mapping.
- Today, the information is much more detailed and can be used to create accurate maps.

Topographic maps

2.4 Vertical aerial photographs

2.4.1 Description

- Overlapping photographs taken vertically above the ground using a specially adapted camera with film.
- Thousands of photographs are taken while the aeroplane flies over a planned route.
- Vertical aerial photographs are used for making topographic maps.
- Many vertical aerial photographs have a larger scale than topographic maps, so features appear larger.

2.4.2 Advantages

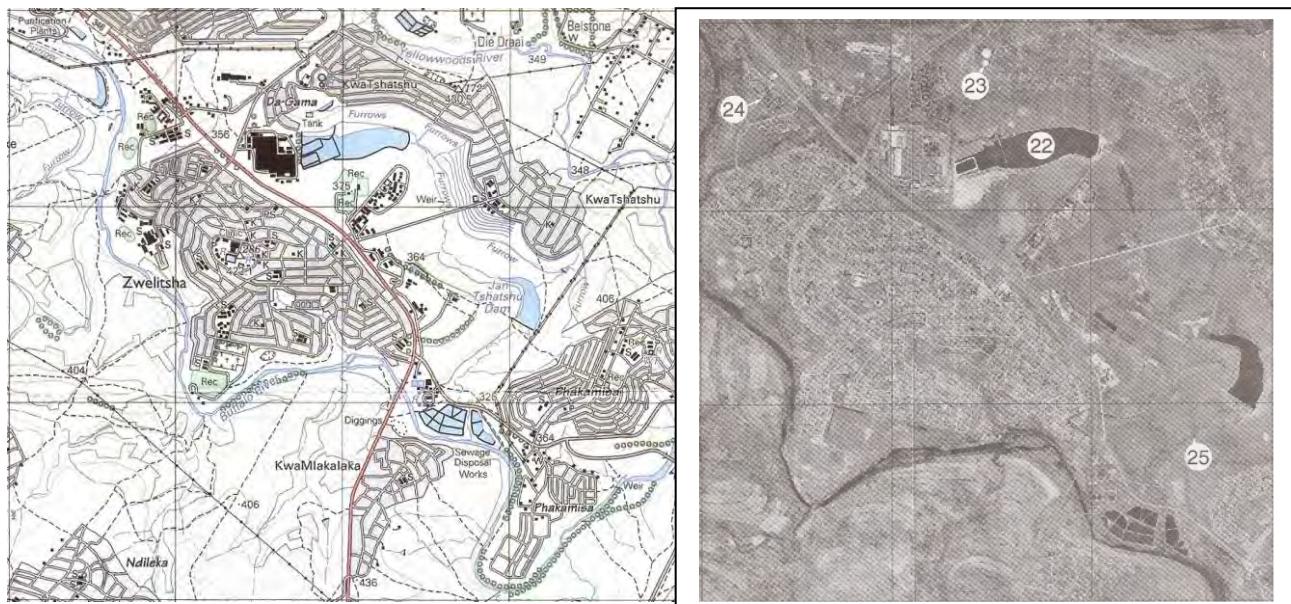
- Source of spatial data for mapping.
- Available in different scales for the whole country.
- Collection contains a historic record of photographs used to monitor settlement, economic growth and development since 1930.

2.4.3 Disadvantages

- The scale on each photo is only correct at the centre. Most images are in black and white.
- Must be scanned and digitised before they can be used for mapping.

2.4.4 Developments

- Cameras have been automated and film quality has improved.
- Photographs developed from camera film are not used that much today for making maps.



The images above show a comparison of an extract of a topographic map (on the left) and a vertical aerial photograph of part of the same area. (Note that the scales are not the same.)

Topographic maps

Unit 3 Topographic maps

3.1 What are topographic maps?

Topographic maps are made by using the information from vertical aerial photographs. They are vertical views of the landscape, and contain numerous symbols.

3.1.1 Description

- A detailed colour map at a scale of 1:50 000 that shows natural and constructed features.
- Mapped from vertical aerial photographs.
- Has a line scale, grid reference lines, title and key (reference list).

3.1.2 Advantages

- Is colour coded and has a map key that guides the user.
- Shows height, distance and can be geo-referenced (because it has lines of latitude and longitude).
- All features that appear provide rich information about the area.
- The whole of South Africa has been represented on topographic maps.

3.1.3 Disadvantages

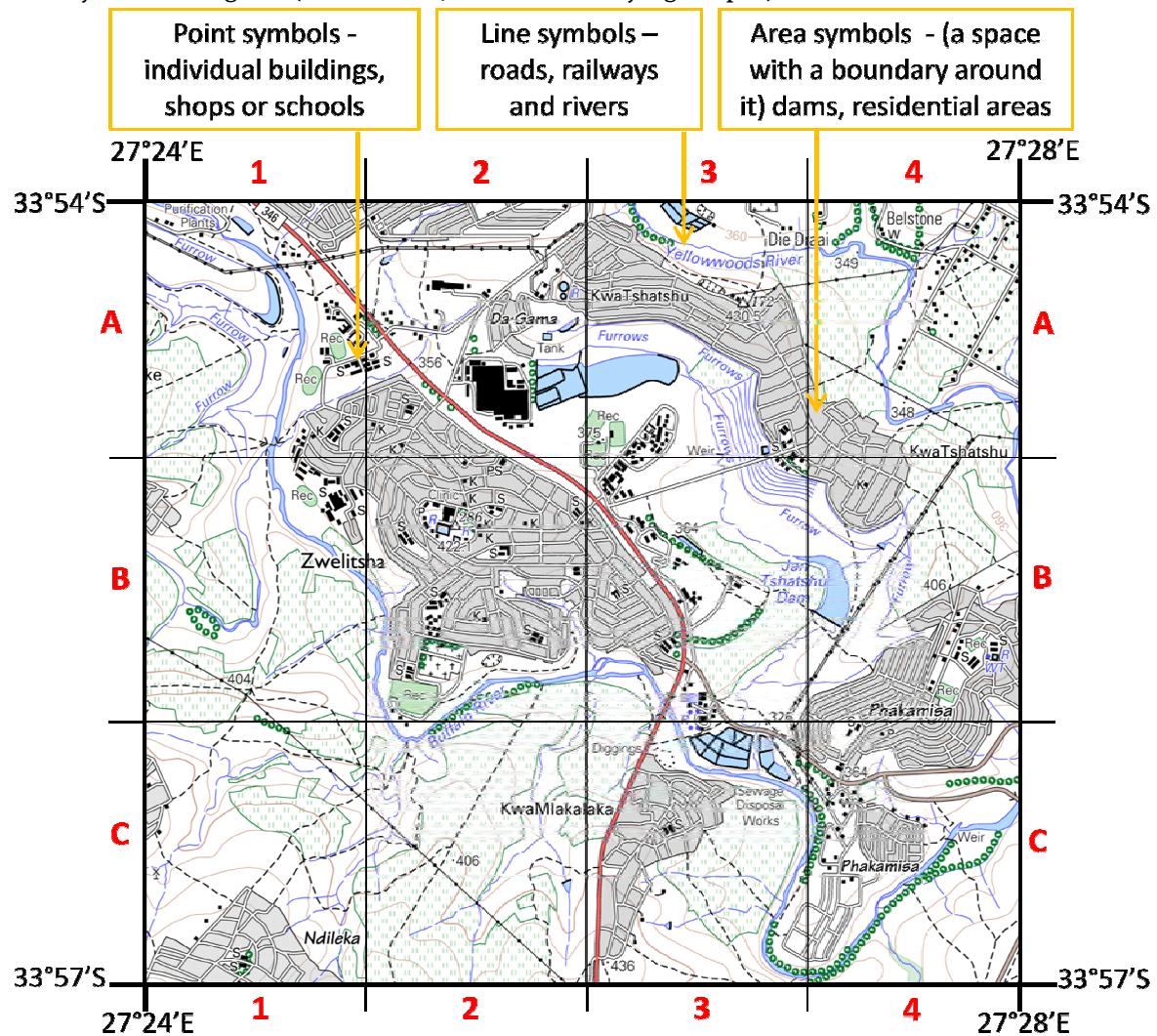
- Does not automatically provide a three dimensional view – height clues have to be identified and interpreted.
- Small print – requires lots of practical use to become familiar with details and symbols.
- Costly – maps become outdated and have to be replaced with updated ones.

3.1.4 Developments

- Will always have a use, informed and enhanced by remote sensing and GIS information, which is becoming more technologically advanced.
- Will be used less once people have increased access to computers and GIS competence.

3.2 Reading topographic maps

- Vertical view of a place (like the area south of King William's Town illustrated on the following page).
- Three types of symbols are evident – point, line and area symbols.
- Areas can be regular – such as rectangles (for instance, cultivated fields), triangles or circles. Or they can be irregular (for instance, dams have varying shapes).



Extract from 1:50 000 Topographic Map 3227CD King William's Town (Chief Directorate: National Geospatial Information)

Topographic maps

National Freeway; National Route ...	
Arterial Route	
Main Road	
Secondary Road; Bench Mark	
Other Road; Bridge	
Track and Hiking Trail	
Railway; Station or Siding	
Other Railway; Tunnel	
Embankment; Cutting	
Power Line	
Built-up Area (High, Low Density) ...	
Buildings; Ruin	
Post Office; Police Station; Store	
Place of Worship; School; Hotel	
Fence; Wall	
Windpump; Monument	
Communication Tower	
Mine Dump; Excavation	
Trigonometrical Station	
Marine Beacon	
Lighthouse and Marine Light	
Cemetery; Grave	
International Boundary and Beacon	
Provincial Boundary	
Protected Area	
Perennial River	
Perennial Water	
Non-perennial River	
Non-perennial Water	
Dry Water Course	
Dry Pan	
Marsh and Vlei	
Pipeline (above ground)	
Water Tower; Reservoir; Water Point	
Coastal Rocks	
Prominent Rock Outcrop	
Erosion; Sand	
Woodland	
Cultivated Land	
Orchard or Vineyard	
Recreation Ground	
Row of Trees	
Contour line	
Index Contour	
Original Farms	

Map key (reference list) for 1:50 000 topographic maps

3.2.1 Key to the map symbols

- The symbols represent the most important elements on the topographic map that must be interpreted.
- The ‘language’ used to describe specific objects on the map is made up of these symbols.
- The shape, size and colour of symbols do not change.
- The symbols are placed in their correct position (as the actual things they represent on the ground) – therefore directions, distances and geo-references (latitudes and longitudes) between them represent the directions, distances and geo-references in reality.
- Text is always used for place names.

Using atlases

Unit 4 Using atlases

4.1 What is an atlas?

An atlas is an important toolkit for a geographer. It provides critical information about a place; its location, temperature and rainfall distribution, its height above sea level, political boundaries, population density and distribution, resource distribution and vegetation, among other information. These maps have keys that help the reader to interpret information with ease. Using atlases is fun and educational.

4.2 Types of maps in atlases

Types of maps can be grouped according to the **area** they cover.

- A **world map** shows all the continents and oceans of the world.
- A **regional map** shows part of a continent or country or maybe just part of a country such as a province.
- A **local map** shows a small place or area, perhaps a city or town.

Types of maps can be groups according to the **topic** they cover.

- On a **political map**, boundaries between areas or countries are shown. Each country or area is a different colour and each country or area is named.
- On a **relief map**, height clues show the altitude (or height) of the landscape from low lying areas up to high mountains. The mountains and rivers are usually named in clear text.
- On a **thematic map**, colours in different shades show information about a place. Each thematic map is based on a different theme, such as climate, vegetation or population.

Atlas maps have a grid of lines – alphabets across and numbers down – called alphanumeric grids. Atlas maps show symbols, just like topographic maps. You need to become familiar with:

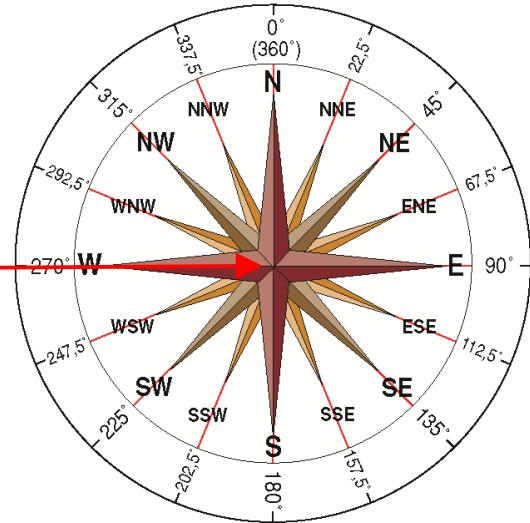
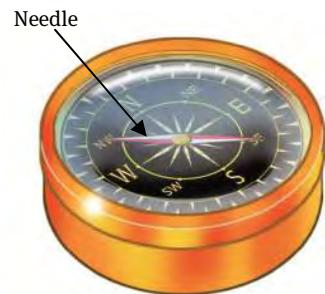
- Map scale
- Map symbols
- Map grids.

Map skills

Unit 5 Map skills

5.1 Describe direction with a compass

- You can describe the direction of features, places and objects around you in the field by using a magnetic compass.
- The needle on a magnetic compass always points to the magnetic north.
- To determine the direction – by way of the eight cardinal points shown on the compass – you first must turn the casing (like a loose lid) on the compass so that the north on the compass card lines up with the needle.
- The 16 compass points help you to describe the direction of places or features from and to a main point of reference (you, a place on the map, an object).
- First identify your main point of reference – where you are describing direction **from**.
- Make a transparency of the compass graphic on the right. Place the middle point of the graphic on the main point of reference.
- Remember, on a map the north of the graphic must be aligned to the true north shown on the map.
- Find the line radiating out from the mid-point at the main frame of reference to the place that you are giving direction **to**.
- Describe the direction.

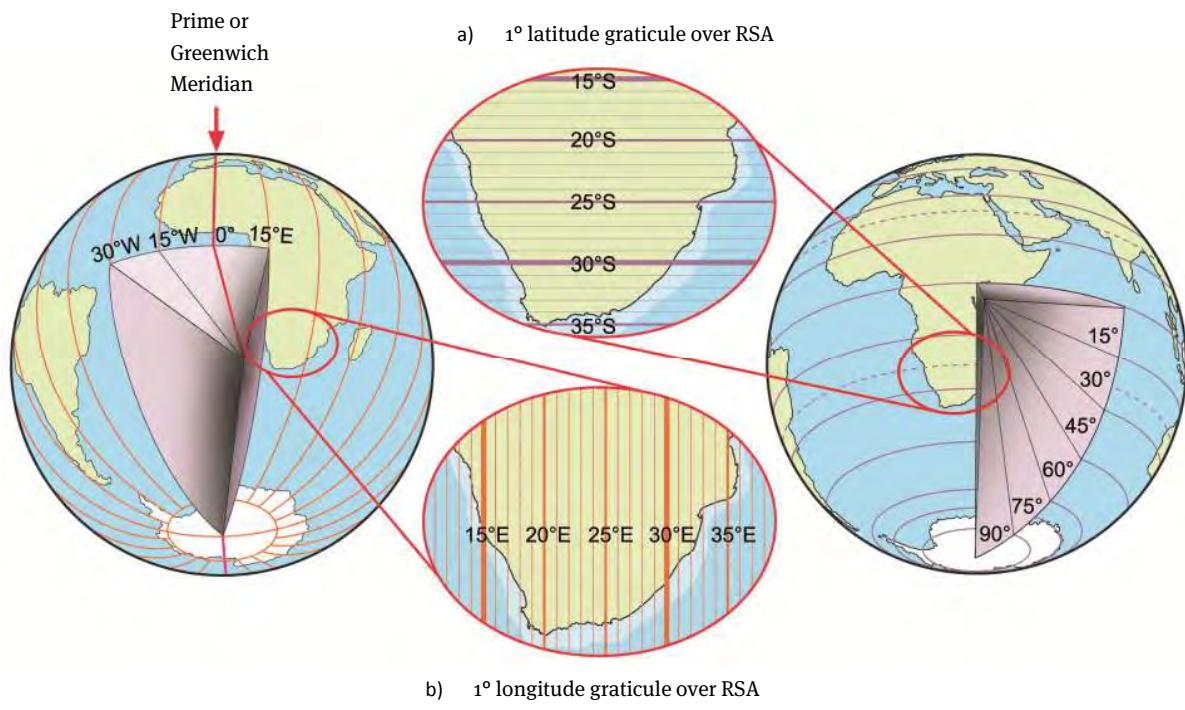
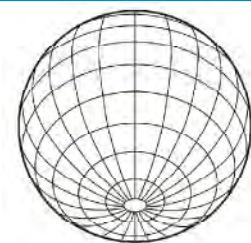


Compass card showing directions and bearings

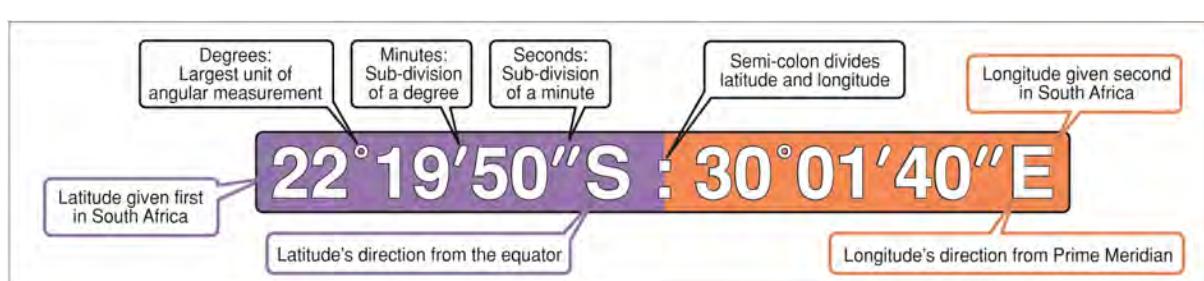
5.2 Describe position with co-ordinates

- All places and features on the Earth have a position.
- The position can be described accurately by giving its co-ordinates.
- The co-ordinates are intersections between lines of latitude (measured in degrees north and south of the equator) and lines of longitude (measures in degrees east and west of the Greenwich meridian).
- These lines form an imaginary geographical grid around the Earth. This is known as a graticule.

Map skills



When writing geographic co-ordinates, comply with the following conventions.



5.3 Recognise different map projections

What are map projections? The graticule on the globe can be flattened out in many different ways to make a flat map. The shapes made by the lines of latitude and longitude on the globe are squares near the equator. Because the Earth is spherical, they taper near the poles, appearing more triangular in shape.

When cartographers produce or draw a flat map of the Earth, they must be careful to conserve four important properties of map projections:

Map skills

- Shape – flattening regions on a curved globe without distorting their shapes too much.
- Area – ensuring that the areas of regions remain in proportion to each other according to their size.
- Direction – ensuring the directions between places are correct.
- Distance – correctly representing the distance between places.

<p>MERCATOR PROJECTION (1569)</p> <ul style="list-style-type: none"> • This projection was developed for navigation. • It shows coastlines, angles and directions accurately. • It distorts shape and distance, especially in the polar regions. 	<p>A</p>
<p>ROBINSON PROJECTION (1961)</p> <ul style="list-style-type: none"> • This projection represents the spherical shape of the globe. • It conserves the relative shape of landmasses. • It distorts direction and distance. 	<p>B</p>
<p>PETERS PROJECTION (1972)</p> <ul style="list-style-type: none"> • An equal area projection that conserves direction. • It shows the sizes of land masses accurately. • It distorts the shape of land masses, favouring developing countries. 	<p>C</p>

Map skills

5.4 Measure bearings

- A bearing is a measurement (in degrees) of the position of one place (see centre point of red arrow) relative to another place (arrow head of blue arrow). The bearing is 135 degrees.
- Therefore, a bearing is recorded as an angle with the use of a 360 degree guide or protractor.
- In this case a magnetic bearing was measured, because the magnetised needle inside a compass is attracted to magnetic north.
- True north lines extend from the north pole to the south pole and are parallel to a straight line of longitude.
- Magnetic north moves very slightly all the time and does not correspond with true north.
- There is always an angle between a true north line and a line pointing to the magnetic north. This angle is called the magnetic declination.
- The changing angle of the magnetic declination is provided on a topographic map as, for example:

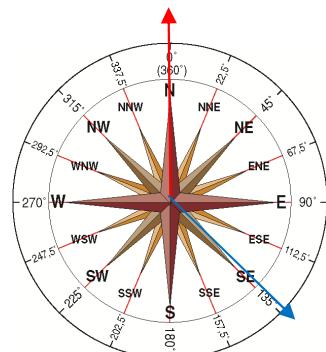
Mean magnetic declination 25 degrees 35' west of true north (February 2010)

Mean annual change 5' westwards (January 2010–February 2011)

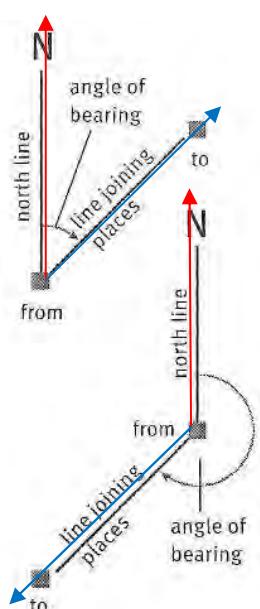
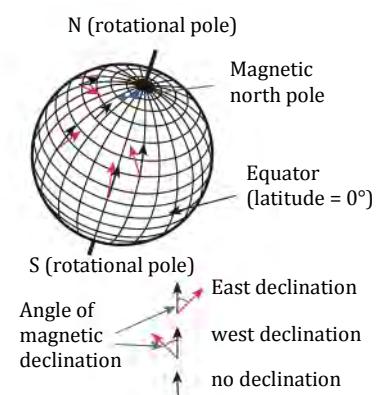
- This means that the mean magnetic declination from 2010 to 2011 increased by 5' and is thus 25 degrees and 40' west of true north.
- From South Africa, magnetic north always lies west of true north.
- If you have to rely on a magnetic bearing, then you have to add the angle of magnetic declination.
- If you subtract the angle of magnetic declination from your measured bearing then you have obtained the true bearing.
- When the bearing is measured relative to a true north line – aligned to the true north line on a topographic map – then true bearing is measured.

5.4.1 Steps to measure an angle

- Identify the places FROM and TO and join the line.
- Draw a true north line from your main frame of reference, that is, from FROM.
- Measure the angle from true north to the line joining places.



Compass card showing directions and bearings

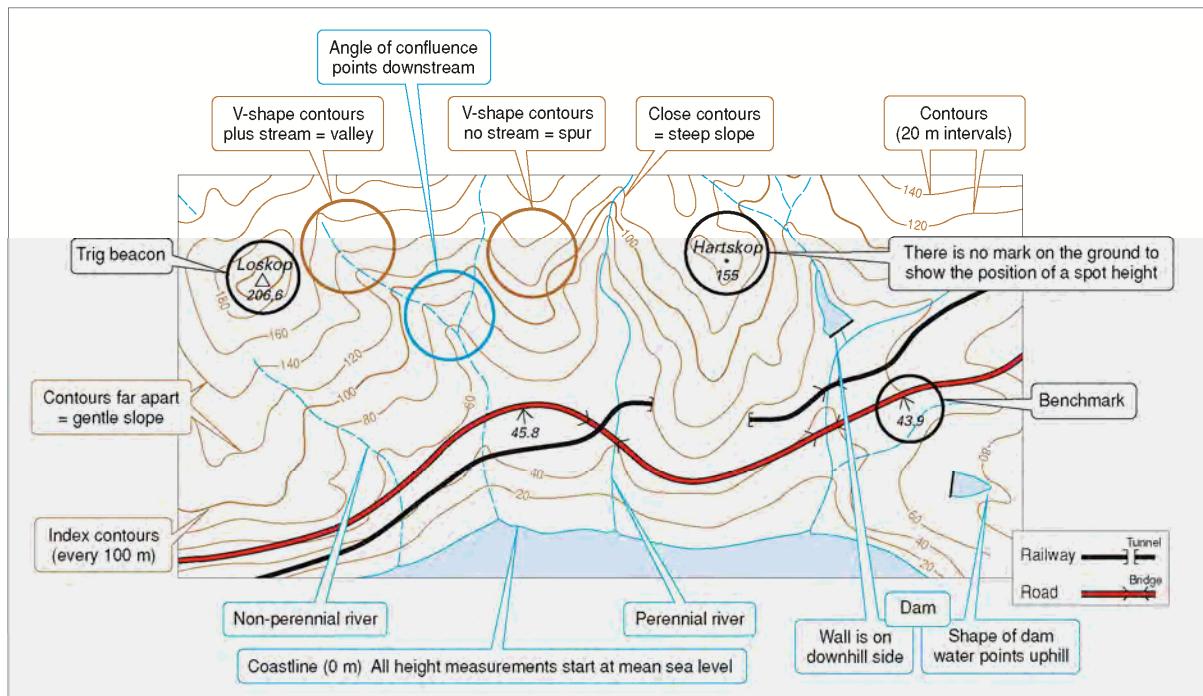


Map skills

5.6 Identify landforms

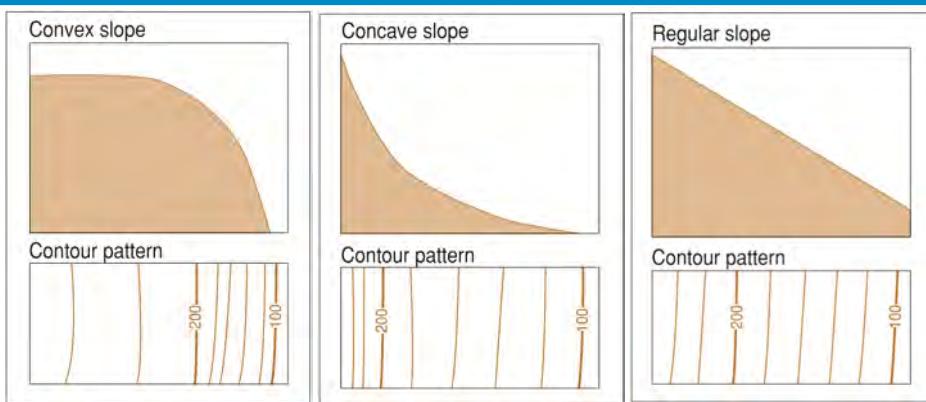
- There are symbols – spot heights and contours – on a map that represent height.
- Contours are the main height clues. These are lines joining points of equal height.
- Height is given in metres on topographic maps.
- Contour intervals of 20 metres are used on topographic maps.

Learn the various height clues on the map below, and the related landforms and features.



- The pattern of contour lines provides important clues to the shape of the landforms that make up the relief of the whole area.
- Relief consists of different landforms, such as mountains, valleys and plains.
- Slopes are important features of landforms and determine where people live, plant and build.
- Widely spaced contours represent gentle terrain.
- Closely drawn contours represent steep slopes.
- Widely spaced contour lines followed by closely drawn contours yield a convex slope.
- Closely drawn contour lines followed by widely spaced contours yield a concave slope.
- Regular slopes are characterised by evenly spaced contour lines

Map skills



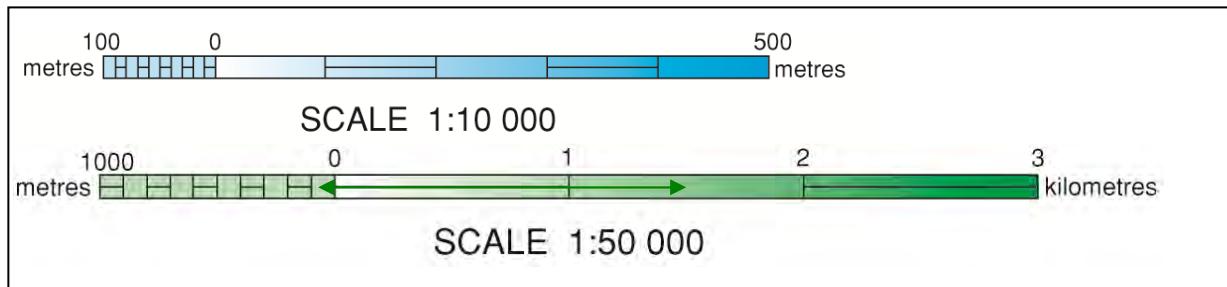
Contour patterns of landforms and matching profiles

5.7 Measure distance

- Maps are drawn to scale.
- Therefore ground distances can be calculated between features or places on a map.
- The scale provided on the map is critical to use when calculating distance.
- The map scale is the relationship between map distance and ground distance.
- Distances on the ground are measured in kilometres (km). These large distances are represented by centimetres (cm) on a topographic map.
- Thus map scales have proportionate values, for instance 1:10 000 or 1:50 000.

5.7.1 Ratio (number) and word scales

- The scale on a topographic map is 1:50 000. This is a ratio scale.
- Stated in words it means that 1 cm on the map represents 50 000 cm on the ground. As 100 000 cm is equivalent to 1 km then 50 000 cm is equivalent to 0,5 km on the ground.
- Ratio scales require knowledge of conversions from centimetres to metres or kilometres, depending on what is asked in a classroom activity, test or examination.



Open line scales: the distance to the left of zero is subdivided into smaller units of measurement

- The line scale (above) is used to read off ground distance quickly.
- It is the easiest type of scale to use.
- Read off the distance of the double pointed green arrow. It is 2 400 metres or 2,4 km.
- No calculation is required to convert map distance into ground distance.
- The left side of the line scale facilitates more accurate measurements.

Map skills

5.7.2 Steps to using a number scale

- Measure map distance in cm.
- Multiply by the scale factor.
- Convert answer to km (divide by 100 000 km) or metres (divide by 100).
- Example: $4 \text{ (cm)} \times 50\ 000 / 100\ 000 = 2 \text{ km}$

5.7.3 Large and small-scale maps

- Small-scale maps of 1:50 000 indicate that a distance of 50 000 cm on the ground is compressed into 1 cm on the map. This means that the map is compressed and the features shown will be small.
- In contrast, a larger scale map of 1:10 000 means that only 10 000 cm on the ground is illustrated in 1 cm on the map. Thus this map is less compressed and more detail is shown. Further, the features shown on a 1:10 000 scale map are larger than on a 1:50 000 scale map.

Fieldwork

Unit 6 Fieldwork

6.1 Steps for conducting fieldwork

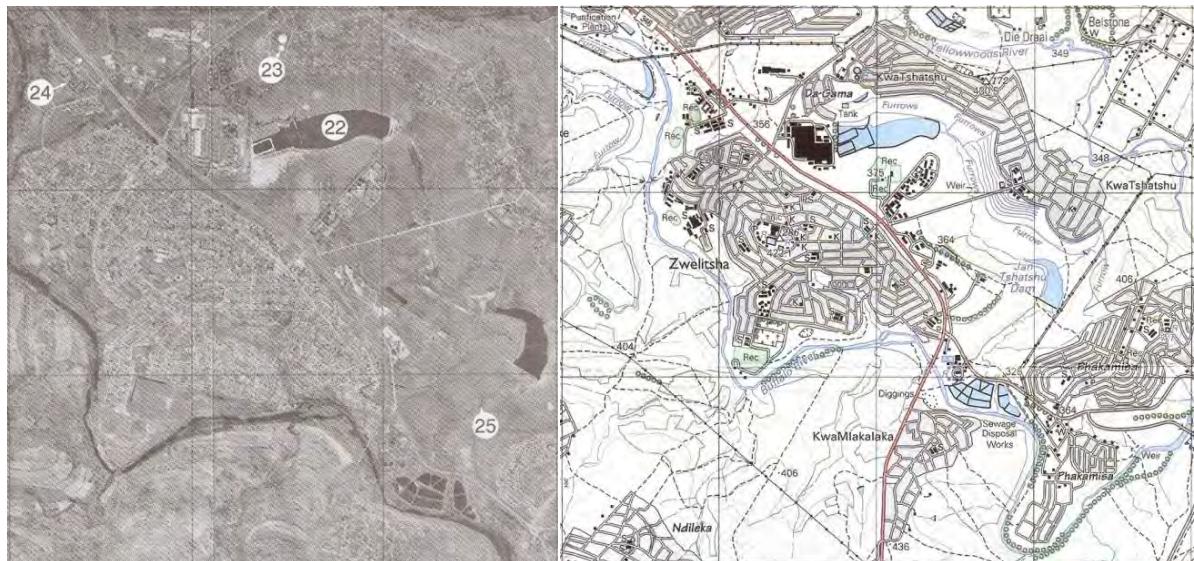
F	<u>FINDING A TOPIC</u>	<ul style="list-style-type: none"> Search the local media, brain storm or engage in discussions with people regarding an issue or problem that is affecting the local community or the environment. The topic must be current, relevant and interesting.
I	<u>INFORMATION GATHERING</u>	<ul style="list-style-type: none"> Identify how you are going to gather your information. Will you need to research more about the topic before actually investigating or conducting fieldwork?
E	<u>ENGAGING WITH STAKE-HOLDERS/LOCAL ENVIRONMENT</u>	<ul style="list-style-type: none"> Who is going to be the source of information? You can use surveys in the form of questionnaires to gather information or templates to observe or count – complete a census.
L	<u>LOCALISING YOUR INVESTIGATION/FIELDWORK</u>	<ul style="list-style-type: none"> Plan your fieldwork within the local context. Engage with the local community within your local environment. Take the appropriate safety measures when conducting fieldwork.
D	<u>DATA GATHERING</u>	<ul style="list-style-type: none"> Decide if the data you are gathering is quantitative (counting, averaging, ranking) or qualitative (gathering perspectives, opinions, facts). Appropriate data gathering devices must be used for reliable and valid findings, for instance tape recorder, thermometer, camera.
W	<u>WORKING EFFECTIVELY</u>	<ul style="list-style-type: none"> Plan your schedule and time manage the phases of the fieldwork. If it involves group work, ensure that all group members are allocated roles and deadlines.
O	<u>ORGANISING YOUR DATA</u>	<ul style="list-style-type: none"> Sieve your data into fact, opinion, consensus, notable contrasts. Organise your data into key themes and sub themes. Be objective when evaluating the data at hand.
R	<u>RECORDING AND REPORTING YOUR FINDINGS</u>	<ul style="list-style-type: none"> Record your findings according to the relevant themes and sub themes. Write a concise report using an accepted format.
K	<u>KEY FINDINGS, RECOMMENDATIONS AND CONCLUSIONS</u>	<ul style="list-style-type: none"> Summarise your key findings. Make recommendations – your own and those obtained from respondents that are relevant. Draw conclusions from your fieldwork.

Introduction to geographical skills and techniques

Questions

Question 1

- 1.1 Identify features 22, 23, 24 and 25 on the following vertical aerial photograph, with the aid of the accompanying topographic map extract. (8)

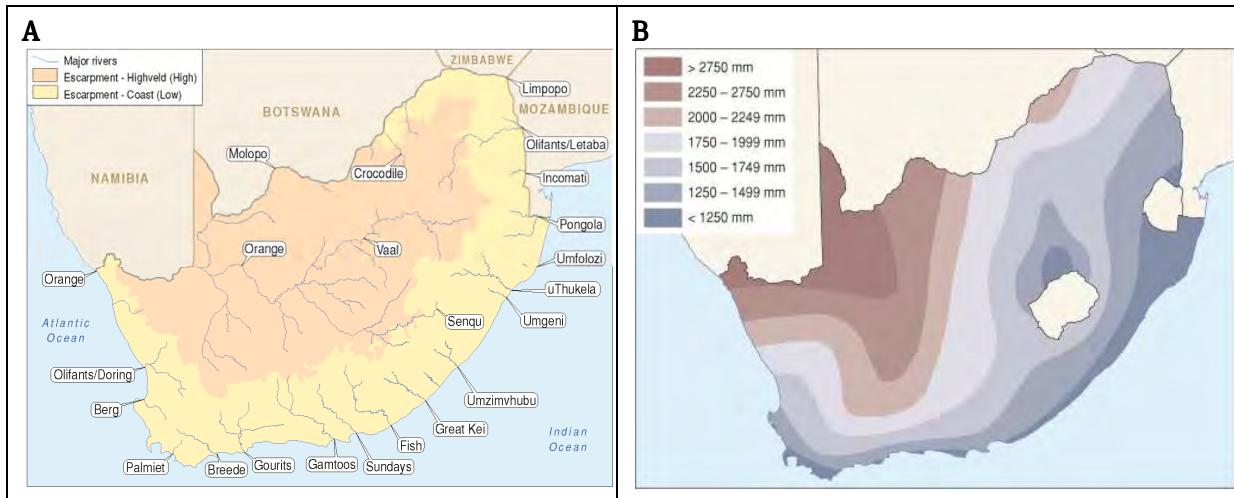


- 1.2 From the topographic map extract in question 1.1 above, describe the symbol that represents: (a) a spot height; (b) a river; (c) an industrial site; (d) a furrow and (e) cultivated land. (10)

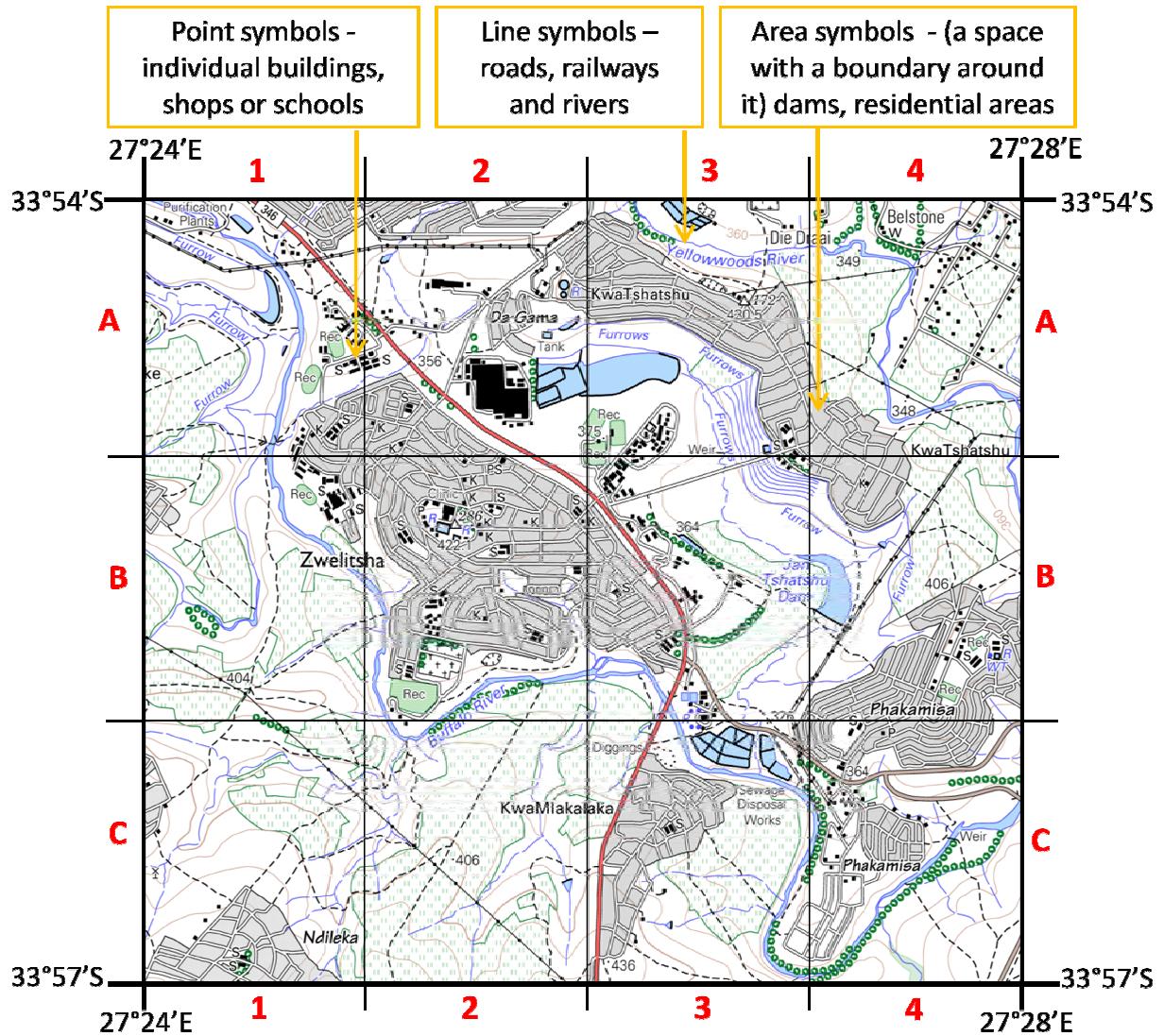
- 1.3 From the map key for a 1:50 000 topographic map:

- 1.3.1 Describe the symbol that is used to represent: (a) a railway station, (b) a bridge and (c) a lighthouse. (6)
- 1.3.2 Differentiate between: (a) perennial and non-perennial rivers, and between (b) national and arterial roads. (4)

- 1.4 What types of maps are shown in A and B below. Give reasons for your answer. (4)



- 1.5 With reference to the topographic map of King William's Town below, in terms of compass points, describe the direction of the following places or features from the Jan Tshatshu Dam, using T in Tshatshu as main point of reference: (a) sewage disposal works, (b) diggings, and (c) spot height 364. (6)



- 1.6 On the King William's Town topographic map extract in question 1.5 above, use the spot heights to describe the height of the ground: (a) to the north and northeast, and (b) to the south and southwest of the Jan Tshatshu Dam. (4)
- 1.7 Calculate the distance in kilometres from the centre of the Jan Shatshu Dam wall to trig beacon 172 (in A3) on the King William's Town topographic map extract in question 1.5 above. (4)

Introduction to geographical skills and techniques

Answers to Questions

Question 1

- 1.1 22 – perennial water; 23 – water reservoir; 24 – recreation ground; 25 – non-perennial river (drainage area) (8)
- 1.2 (a) a dot and number; (b) – blue line; (c) – large black blocks; (d) – blue line (labelled furrow); (e) – green line around an area marked with evenly spread green double commas (10)
 - 1.3.1 (a) – white rectangular block on black line; (b) – two arrow points facing each other; (c) – red star (6)
 - 1.3.2 (a) perennial rivers – solid blue line, sometimes thick; non-perennial rivers – broken blue line; (b) national road – red line marked by N in a pentagon shape; arterial road – red line marked by R in diamond shape (4)
- 1.4 A – regional map showing location of rivers; B – thematic map showing distribution of evaporation rates (4)
- 1.5 (a) south; (b) south west; (c) north northwest (6)
- 1.6 (a) To the north and northeast, ground increases in height gradually to 348 m then to 349 m. (b) To the south and southwest, ground decreases in height to 326 m then increases to 436 m.
- 1.7 Distance from Jan Shatshu Dam to trig beacon 172 = $4,6 \text{ cm} \times 50\ 000 \text{ cm}$ (2)
 $= 230\ 000 / 100\ 000 \text{ km}$
 $= 2,3 \text{ km}$ (2)

Overview

This section comprises four units. These are the composition and structure of the atmosphere, the heating of the atmosphere, moisture in the atmosphere, and reading and interpreting synoptic weather maps. Key concepts and processes related to the study of the atmosphere are explained using different forms of data, including synoptic and other maps, satellite images, tables and graphs. Apart from assessing if you have sufficient knowledge of these concepts and processes, you also will be expected to be able to apply your understanding in familiar and unfamiliar contexts. You also will be required to extract information from data or information sources in an assessment like an examination, a test or a task. Sometimes you may be required to provide a neatly labelled sketch of a key concept or process. Several other important skills are presented in this section, including cause and effect relationships, interpreting climate graphs, maps, satellite images, interpreting and summarising information from illustrations. This section will help you to study the atmosphere as both beneficial and sometimes life threatening.

Unit 1

- 1.1 Understanding the atmosphere as a system
- 1.2 Why is the atmosphere so important?
- 1.3 What is the composition of the atmosphere?
- 1.4 What is the structure of the atmosphere?
- 1.5 The ozone layer in the atmosphere

Unit 2

- 2.1 Temperature changes over time and space
- 2.2 Processes associated with the heating of the atmosphere
- 2.3 What are the ways insolation is spread in the atmosphere?
- 2.4 How is energy transferred from the Earth's surface?
- 2.5 What factors affect the temperature of different places?
- 2.6 The Greenhouse effect (enhanced effect and impact)

Unit 3

- 3.1 The different forms and quantities of water
- 3.2 Evaporation and condensation
- 3.3 Humidity
- 3.4 Clouds
- 3.5 Precipitation

Unit 4

- 4.1 What are synoptic weather maps and why are they important?
- 4.2 What are the symbols used on South African synoptic weather maps?
- 4.3 How are satellite images used by meteorologists?

Composition and structure of the atmosphere

Unit 1 Composition and structure of the atmosphere

1.1 Understanding the atmosphere as a system

The atmosphere is a system that is made up of parts that work together. These are:

Inputs (What goes into the atmosphere?)

- Insolation (INcoming SOLar RadiATION)
- Particles from space
- Heat, gases and solids from the Earth

Stores (What is stored in different formats in the atmosphere?)

- Heat energy
- Moisture (as water, water vapour and ice)
- Gases: constant gases (nitrogen, oxygen); variable gases (carbon dioxide, ozone); inert/noble gases (argon, helium, neon, krypton)
- Non-gases (dust, salt and smoke particles)
- Pollutants

Outputs (What goes out to the atmosphere and space?)

- Heat from the Earth (terrestrial radiation)
- Gases (oxygen from photosynthesis)
- Solids (from volcanoes, soil erosion and fires)
- Moisture (from evaporation and transpiration)

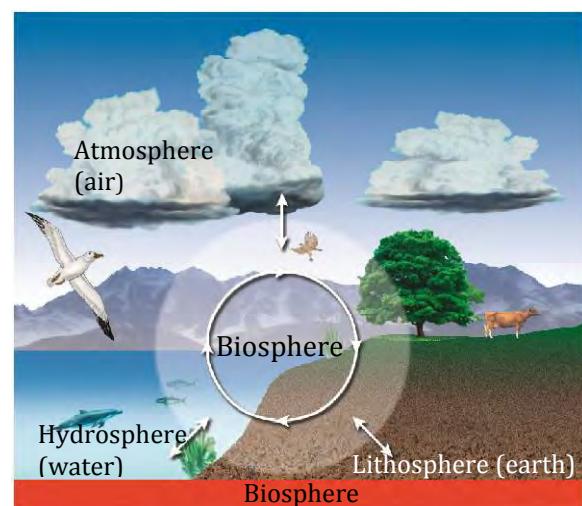
1.1.1 What is the significance of the atmosphere?

The atmosphere is a part of the Earth's structure. It is a sphere of gases, liquids and suspended particles. Three other spheres, which are in constant interaction with each other, form the natural environment. These are:

- the lithosphere (soil and rocks)
- the hydrosphere (water bodies including the frozen regions)
- the biosphere (that portion of the Earth and atmosphere which supports life).

1.2 Why is the atmosphere so important?

The atmosphere provides oxygen for all life, absorbs harmful radiation, burns up meteors, allows just enough heat through during the day to sustain life, and holds just enough heat at night to stop us from freezing.



Composition and structure of the atmosphere

1.3 What is the composition of the atmosphere?

The following table summarises the gases in the atmosphere, the amount of each in the atmosphere, as well as its importance for life on Earth.

Gases in the atmosphere and their significance				
Type of gas	Gas	Percentage by volume	Importance for weather and climate	Other functions/source
Constant gases	Nitrogen (N_2)	78.09	<ul style="list-style-type: none"> Mainly passive 	<ul style="list-style-type: none"> Needed for plant growth
	Oxygen (O_2)	20.95		
Variable gases	Water vapour (H_2O)	0.03 (can rise to 4.0)	<ul style="list-style-type: none"> Source of cloud formation and precipitation; reflects/absorbs incoming radiation; keeps global temperatures constant 	<ul style="list-style-type: none"> Essential for life on Earth; can be stored as ice/snow
	Carbon dioxide (CO_2)	0.03	<ul style="list-style-type: none"> Absorbs long-wave radiation from the Earth and so contributes to 'greenhouse effect'; its increase, due to human activity, is a major cause of global warming 	<ul style="list-style-type: none"> Used by plants for photosynthesis; increased by burning fossil fuels and by deforestation
	Ozone (O_3)	0.00005	<ul style="list-style-type: none"> Absorbs incoming ultraviolet radiation 	<ul style="list-style-type: none"> Reduced / destroyed by chlorofluorocarbons (CFCs)
Inert or noble gases	Argon (Ar)	0.93	<ul style="list-style-type: none"> 	<ul style="list-style-type: none">
	Helium (He), neon (Ne), Krypton (Kr)	Trace	<ul style="list-style-type: none"> 	<ul style="list-style-type: none">
Non-gases	Dust, salt and smoke particles	Trace	<ul style="list-style-type: none"> Absorb/reflect incoming radiation; form condensation nuclei necessary for cloud formation 	<ul style="list-style-type: none"> Come from volcanoes, meteorites, soil erosion by wind
Pollutants	Sulphur dioxide, methane	Trace	<ul style="list-style-type: none"> Affect radiation; cause acid rain 	<ul style="list-style-type: none"> From industry, power stations and car exhausts

Composition and structure of the atmosphere

1.4 What is the structure of the atmosphere?

- Four distinct layers make up the atmosphere's structure.
- Three of these layers are found in the homosphere (troposphere, stratosphere and mesosphere); one is found in the heterosphere (thermosphere).
- Homosphere (± 80 km above the Earth's surface)
- Constant gases (fixed mixture)
- Nitrogen (78,09%), oxygen (20,95%), inert/noble gases (0,93%)
- Variable gases (varied mixture)
- Heterosphere (>100 km above the Earth's surface)

1.4.1 What are the layers of the atmosphere, from Earth's surface upwards?

Troposphere

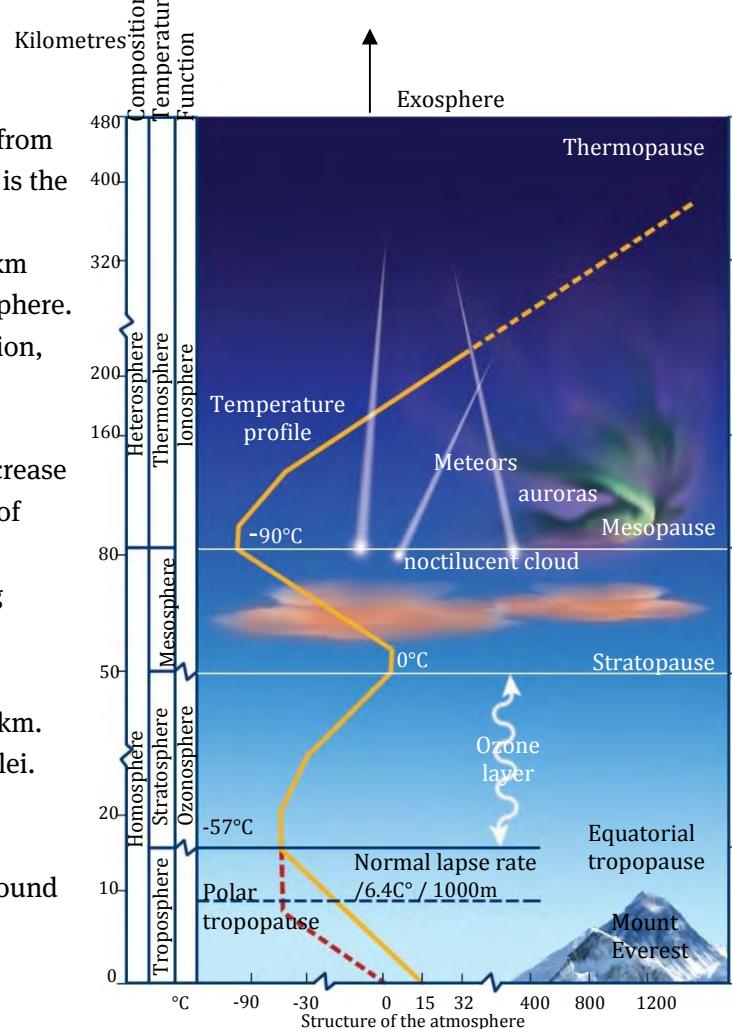
- The troposphere is the layer directly above the Earth's surface.
- It extends up from surface for 12 km. The upper boundary of the layer is the tropopause.
- It is warmed by the Earth's long-wave radiation, and processes like conduction and convection.
- The temperature decreases with increasing altitude at average rate of $6,4^{\circ}\text{C}/1000\text{ m}$. This is called the environmental/normal lapse rate.
- All weather processes take place in this layer. This is why passenger planes fly just in the tropopause.
- Air pressure falls with height.

Stratosphere

- The stratosphere layer extends in altitude from 12-50 km. The upper boundary of the layer is the stratopause.
- The ozone layer is situated between 15-35 km above the ground and is called the ozonosphere. Ozone absorbs incoming ultraviolet radiation, which may be harmful to humans, other animals and plants.
- The stratosphere is characterised by an increase in temperature caused by a concentration of ozone.
- It acts as protective layer against incoming meteorites.

Mesosphere

- The mesosphere layer extends from 50-80 km.
- It receives meteoric dust, which forms nuclei.
- Noctilucent clouds form from ice crystals.
- Temperature falls rapidly, with lowest temperatures of -90°C . Ice crystals form around nuclei. Strongest winds are recorded.



Composition and structure of the atmosphere

Thermosphere

- The thermosphere is the uppermost layer of the atmosphere, from 80-480 km. Uppermost boundary is the thermopause.
- There is a rapid increase in temperature with increase in height, to 1500°C.
- Solar radiation is absorbed by atomic oxygen.

1.5 The ozone layer in the atmosphere

Highest concentrations of ozone are found between 15-35 km above the Earth's surface, in the stratosphere. Under natural conditions ozone is formed and destroyed all the time.

Ozone absorbs the harmful ultraviolet (UV) rays from the Sun. (Also look at the other types of rays from the Sun in figure 40 on page 52 in the Learner's Book.)

Ozone depletion, together with a number of unusual climatic conditions, cause an 'ozone hole' over Antarctica. It is most noticeable in spring because of more intense heating in the Southern Hemisphere.

Composition and structure of the atmosphere

As a geography learner, you often will be required to make connections between different types of information and/or data.

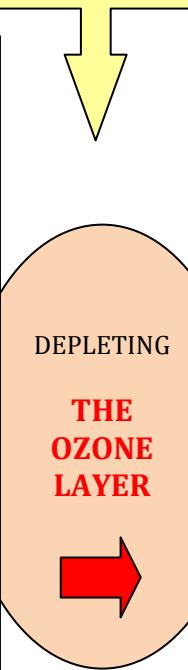
You will be required to understand **cause and effect** relationships, as in this case of ozone depletion.

Such relationships will reappear when you study the greenhouse effect, global warming and weather shown on the synoptic chart.

Causes

Human activities are destroying ozone more rapidly than it is being formed. The main gases responsible for this are the release of:

- *chlorofluorocarbons* (CFCs) in aerosols, air conditioners and refrigerators
- *halons* in fire extinguishers
- *carbon tetrachloride* in solvents and cleaning agents
- *methane* from burning fossil fuels, and also emitted by animals and wetlands
- *methyl bromide* used in pesticides.



Effects

Increase in skin cancer and in leather-like skin

Increase in eye diseases, for instance cataracts

Weakens immune systems

Disrupts marine food chains

Damages plastic

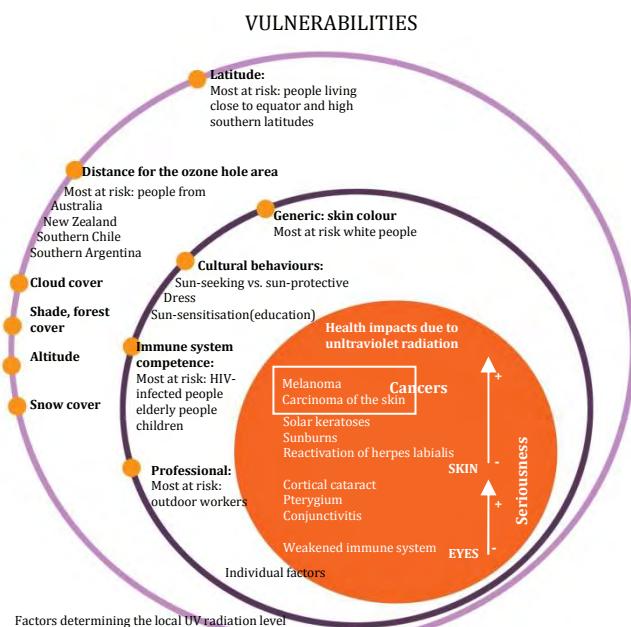
Causes an increase in smog

Reduces photosynthesis, water-use efficiency, dry matter production in crops

Composition and structure of the atmosphere

1.6 Ways to reduce ozone depletion

How can the issue of ozone depletion be addressed? You can only start to deal effectively with the issue when you first have a good understanding of your own vulnerabilities and what factors influence the impact of ozone depletion



Application is important in geography. You always will get diagrams and pictures that you will be required to decode (making them easier to understand).

Illustrations like these give a lot of information or data that needs correct interpretation.

- *Can you identify the two main types of factors that make people vulnerable to ultra violet radiation?*
- *Can you identify the main health impacts?*

Read the information and data carefully and identify the key parts of the illustration and key headings or highlighted words. Then you will be able to summarise the illustration in your own words, or even illustrate it differently so that you understand it

Factors determining the local UV radiation level	Individual factors determining own exposure to UV radiation	Health impacts if at risk
Latitude, altitude Distance from the ozone hole Cloud cover Shade or forest cover, snow cover	Genetic skin colour Cultural behaviour Immune system competence Profession	Sun burn Cancer Leather skin

Heating of the atmosphere

Unit 2 Heating of the atmosphere

2.1 Temperature changes over space and time

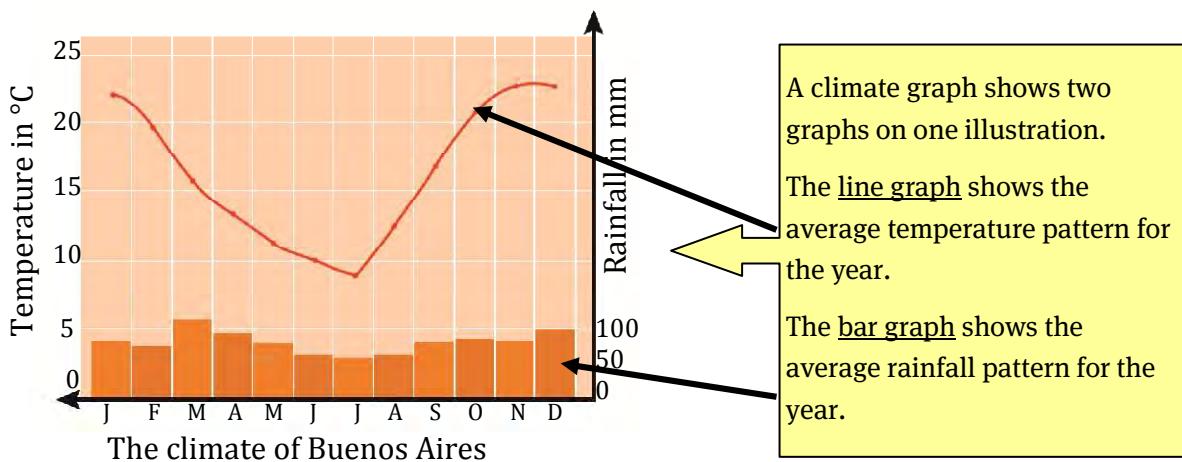
2.1.1 Over space

Temperatures vary over the Earth's surface.

- Hot at the equator
- Cold at the poles

2.1.2 Over time

- As you should know by now, night and day temperatures differ.
- Different seasons also have different temperatures.
- Temperature thus changes over time, as can be seen in the climate graph below.



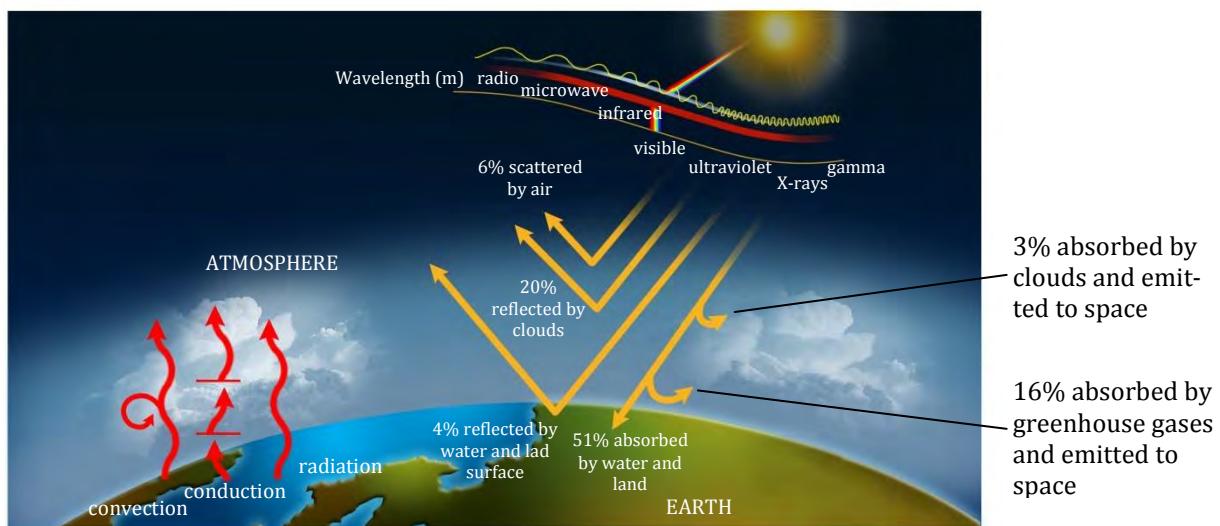
2.1.3 Temperature variations at a place occur at three scales

Scale 1: Advection	Scale 2: Diurnal/daily	Scale 3: Seasonal variations
<p>Advection is due to the horizontal movement of cold or warm air masses. Effect is illustrated by conditions experienced in Berg wind conditions in South Africa.</p>	<p>Mostly influenced by the region's situation and climate. Coastal areas – maritime climate – sea moderates climate – smaller temperature range. Inland areas – continental climate – absence of moderating effect of the sea – larger temperature range and more extreme temperatures.</p>	<p>Higher average temperature in summer – in December in the Southern Hemisphere. Lower average temperature in winter – in June in the Southern Hemisphere. The opposite situation will be experienced in the Northern Hemisphere.</p>

Heating of the atmosphere

2.2 Processes associated with the heating of the atmosphere

- Temperature varies over space (horizontally and vertically) and over time. This drives circulation in the atmosphere.
- The source of nearly all heat energy is the Sun.
- The atmosphere is actually heated by the Earth because insolation passes through the atmosphere and heats the Earth. The Earth becomes a radiating body and gives off terrestrial radiation, which is absorbed by the atmosphere. This is the heat that we feel.



2.3 What are the ways insolation is spread in the atmosphere?

100% incoming insolation is spread by three processes:

- Absorption** (66%) – Water vapour, dust and gas absorb 16%. Clouds absorb 3% – they are poor absorbers. In total, 19% of the radiant energy is absorbed in the atmosphere. The Earth's surface absorbs 51%. About 4% is reflected back to the atmosphere from land and sea surfaces.
- Scattering** (12%) – by dust and gas molecules. 6% insolation is scattered back into space and 6% reaches the Earth's surface and is absorbed there.
- Reflection** (22%) – 20% reflected (back into space) by clouds, 2% by the Earth's water and land surfaces. Shiny white ice has higher reflectivity (albedo) than water and the vegetation of equatorial regions.

2.4 How is energy transferred from the Earth's surface?

The Earth heats its atmosphere through three processes:

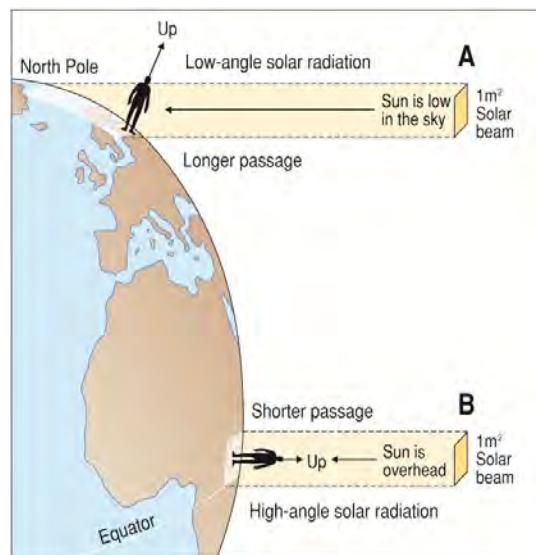
- Radiation** – short-wave radiation reaches the ground and changes to infrared long-wave radiation, which heats the atmosphere.
- Conduction** – occurs in the first metre of the atmosphere, energy moves from molecule to molecule, the molecules do not move, and they are packed together.
- Convection** – heat is distributed by moving molecules. Strong vertical movements by liquids and gases.

Heating of the atmosphere

2.5 What factors affect the temperature of different places?

2.5.1 Latitude

- At A – Sun's rays strike the Earth at a lower angle (indirectly) and solar energy spreads over a larger area.
- Sun's rays go through more atmosphere near the poles, which absorbs more heat and light.
- At the poles most of the heat and light is reflected back into space by white ice and snow (high albedo).
- At B – the Sun's rays strike the Earth at a higher angle and insolation is concentrated over a smaller area, therefore there is greater surface heat. There is less reflection.

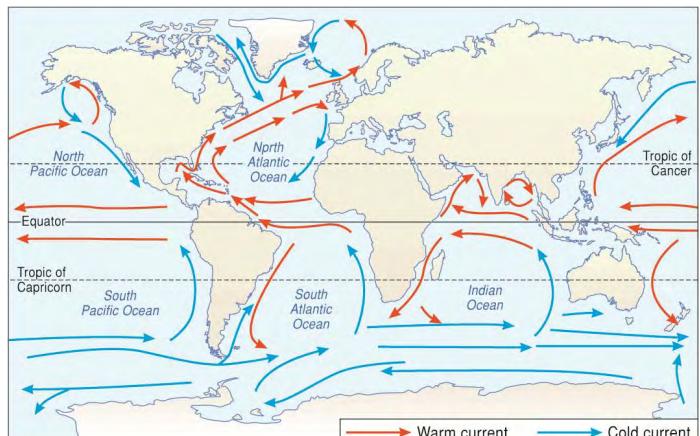


2.5.2 Altitude (height above sea-level)

- Air temperatures increase with height in the troposphere.
- That is because the Earth heats the atmosphere from ground-level. Water vapour and carbon dioxide that absorb heat are also concentrated in the lower atmospheric layers.
- Although Mt Kilimanjaro is situated near the Equator (3°S), its summit (5 895 m above sea level) is covered with snow throughout the year. In contrast, the town of Moshi, a few kilometres south on its lower slopes at a much lower altitude, has an annual mean temperature of 23,3°C.

2.5.3 Ocean currents

- Heat is distributed between the poles and equator through winds and ocean currents.
- Cold air over cold currents from the poles is carried towards adjacent land areas where temperatures are lowered.
- With warm ocean currents from the equator come warmer air masses, which increase the temperature of adjacent land areas.
- In this way the warm North Atlantic Drift keeps Norwegian harbours ice-free.
- In South Africa, the cold Benguela Current along the west coast gives Port Nolloth (29°14'S) a mean annual temperature of 14,2°C. Durban, also on the coast and at nearly the same latitude (29°32'S), has a mean annual temperature of 18,6°C. This is because of the Warm Agulhas (Mozambique) current on the east coast.

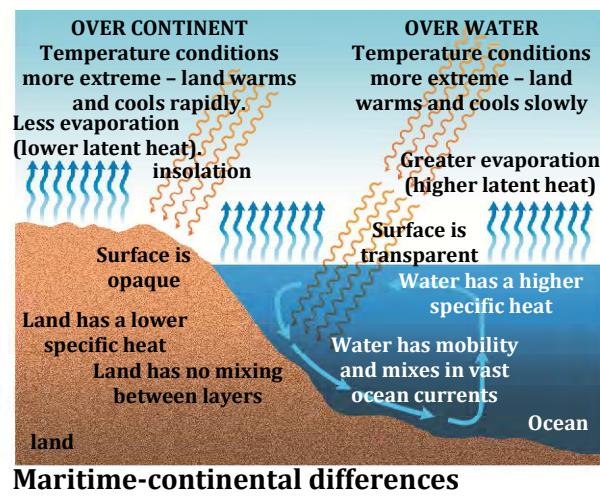


Ocean currents influence the horizontal distribution of temperature

Heating of the atmosphere

2.5.4 Distance from the sea

- Land and water react differently to insolation. This gives rise to two types of climate: maritime (sea) and continental (land).
- Water is transparent. The Sun's rays enter deeper in water (10 m) than in land (25-50 cm).
- Specific heat of water is greater than land. A volume of water requires twice as much heat than the same volume of land to raise its temperature by 1°C.
- Land heats and cools quickly, so the temperature range is larger. The temperature range is the difference between the highest and lowest temperatures (daily, monthly, annually).
- Water heats and cools slowly, so the temperature range is smaller.
- Water moves, distributing heat over a wider area and greater depth. On land the heat is concentrated in the upper most layer.
- The albedo (reflectivity) of water varies more than land. Up to 90% of energy can be reflected off a water surface.



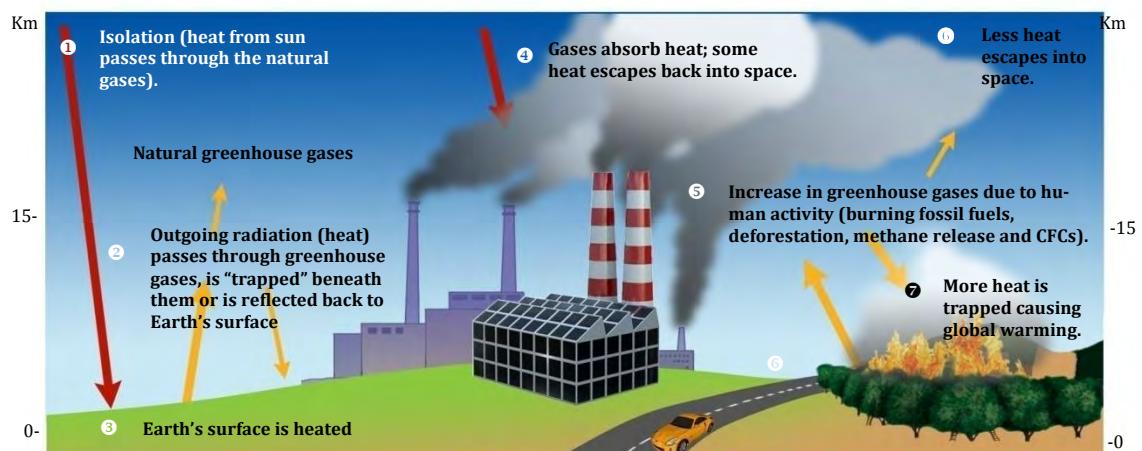
2.6 The greenhouse effect

A greenhouse is used for growing plants in cooler climates. It allows the short-wave radiation to escape, but traps the long-wave radiation. This then heats the air inside the greenhouse and the temperature increases. The atmosphere acts in a similar way, by allowing in the insolation, but then trapping the out-going terrestrial radiation by gases such as carbon dioxide and water vapour. This process, called the 'natural' Greenhouse effect warms the atmosphere.

- Human activities have increased the amounts of greenhouse gases (gases which absorb terrestrial radiation), such as carbon dioxide, methane, CFCs and nitrous oxide in the atmosphere.
- This leads to what scientists describe as the 'enhanced' greenhouse effect – an increase in the 'natural' greenhouse effect, which they fear could result in a gradual increase in the Earth's average atmospheric temperatures and global warming.

See if you can identify the 'natural' and 'enhanced' greenhouse effect processes on the following diagram.

Heating of the atmosphere



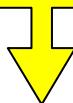
2.6.1 What is the impact of the greenhouse effect on the environment and people?

Impact of the greenhouse effect on the environment and people	
Impact on environment	Impact on people
<ul style="list-style-type: none"> Up to 15% of Nile Valley and 9% of Bangladesh could be flooded; also low-lying areas such as the Netherlands Salt levels will increase (salination), affecting agriculture and coastal ecosystems Floods from storm surges will increase and get stronger Low-lying areas become lagoons or a new coastline Increase in beach erosion Inlets and estuaries will enlarge and deepen Warming will be greater over land than over oceans With increase in greenhouse gases, acid rain will increase Natural habitats of plants and animals will shift Melting glaciers – Mt Kilimanjaro loses glacial ice, affecting local water supply 	<ul style="list-style-type: none"> The amount of arable land will be greatly reduced Loss of fertile agricultural land About 8 million people in Egypt could be homeless Cities like London and Los Angeles could be flooded Increased costs to protect cities Costly structural damage and marine flooding Changes in agricultural patterns, e.g. a decline in the USA's grain belt, but an increase in Canada's growing season Greatest food security risk for poor and landless people Populations in subtropical and mid-latitude areas will be at greater risk of being affected by diseases such as malaria, schistosomiasis (bilharzia) and sleeping sickness

Heating of the atmosphere

2.6.2 How can greenhouse gases be reduced?

In an exam or assignment think creatively about measures that can be taken across sectors **to reduce greenhouse gases**. *What can schools do? What can we do at home? Businesses? Incentives?*



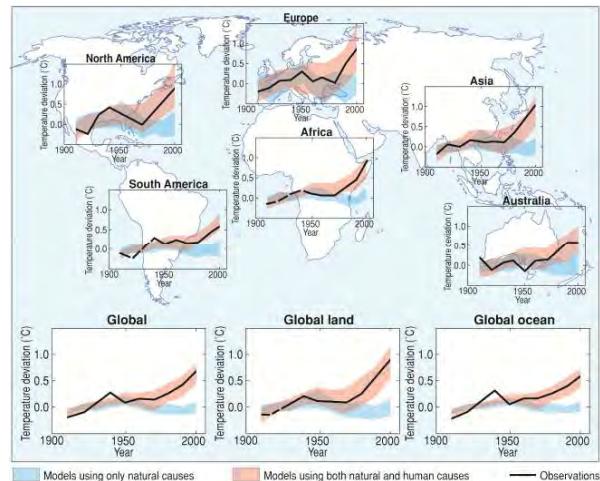
Ways to reduce greenhouse gases		
The energy sector	The transport sector	Other greenhouse gases
<ul style="list-style-type: none"> • Introduce measures to save electricity • Higher standards for domestic appliances • Introduce a carbon tax on electricity generation • Introduce an energy tax on combined heat and power 	<ul style="list-style-type: none"> • Expand public transport systems • Set carbon emission limits on light vehicles • Reduce speed on roads • Do environmental assessments on transport plans and infrastructure investments • Introduce electric vehicles 	<ul style="list-style-type: none"> • Reduce agricultural use of nitrogen fertilisers • Expand methane extraction from waste dumping areas • Reduce emissions of fluorocarbons from aluminium smelters and ban their use as chemicals. • Reduce production of CFCs

Heating of the atmosphere

2.7 Global warming

2.7.1 Is there evidence for global warming?

- Human activities like manufacturing, transport and deforestation, add increasing quantities of greenhouse gases to the atmosphere.
- Each year, these emissions add a further 7 000 million tons of carbon dioxide to the atmosphere, which is likely to stay there for hundreds of years.
- This may lead to global warming, as can be seen from these graphs illustrating temperature increases globally.



2.7.2 How do greenhouse gases cause global warming?

Greenhouse gas	Where is it found	Function	Contribution to global warming (%)
Water vapour	Concentrated in the lowest 10 km of the troposphere	Absorbs a small amount of outgoing radiation.	Clouds and water vapour account for over 97% of the natural greenhouse effect.
Carbon dioxide	Concentrated in lower troposphere	Absorbs long-wave radiation from the Earth	About 50%
Methane	Concentrated in lower atmosphere	Absorbs long-wave radiation from the Earth	About 18%
Nitrous oxide	Concentrated in lower troposphere	Absorbs long-wave radiation from the Earth. Concentrations rise at about 0.3% per year	About 6%
CFCs	Rises to the ozone layer (15 to 50 km above the Earth's surface)		About 24% (lasts about 100 years in atmosphere). By 2030 it is estimated CFCs will account for 33% of global warming).

Heating of the atmosphere

2.7.3 What are the possible impacts on climate and climate change in Africa?

- A possible temperature increase of 4°C by 2080.
- Temperature increase could be as much as +7°C in the south and +8°C in the north.
- Rising sea levels with drastic effects on populated, low-lying areas.
- Climatic changes such as extremes of drought followed by heavy rainfall, which lead to the expansion of deserts.
- Change of weather patterns causing failure of crops.
- Migration of animals and people to avoid increasing aridity.
- Extinction of animals and plants due to habitat change.
- Flooding and conflicts over scarce resources.

Moisture in the atmosphere

Unit 3 Moisture in the atmosphere

3.1 The different forms and quantities of water

3.1.1 What are the different forms of water in the atmosphere?

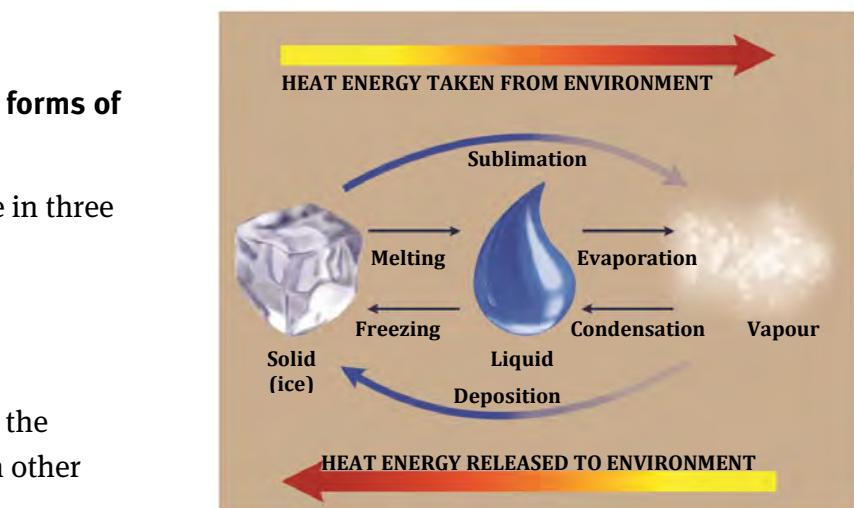
Water exists in the atmosphere in three different physical states:

- gaseous water vapour
- liquid water
- solid ice.

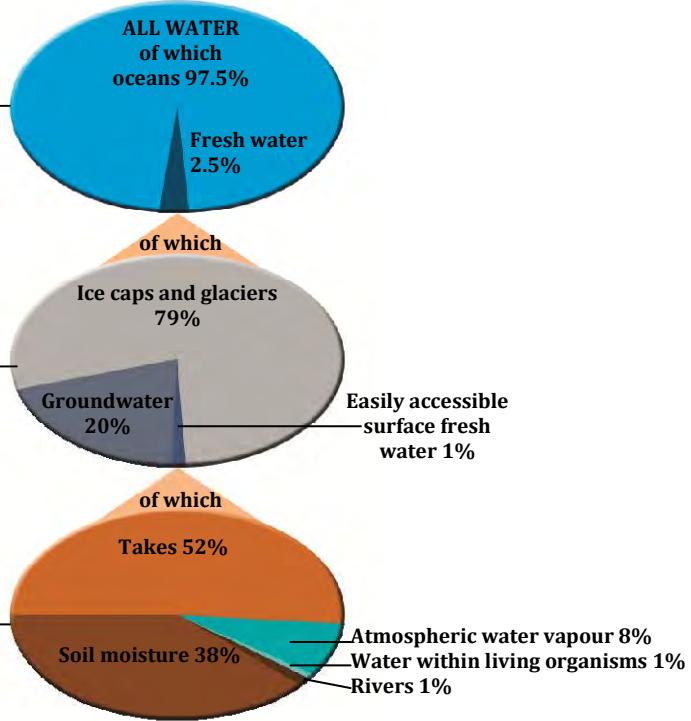
The different states of water in the atmosphere are related to each other through the processes of:

- Evaporation – Liquid water changes to water vapour.
- Condensation – Water vapour changes to water when it cools. If the atmosphere becomes oversaturated, it will lead to precipitation.
- Freezing – Liquid water changes to ice below the freezing point, and heat energy is released.
- Melting – Ice changes to water above the freezing point, and heat energy is absorbed.
- Sublimation – Sometimes ice changes directly into water vapour.

3.1.2 Where can we find water in different forms?



WHERE THE WATER IS



Moisture in the atmosphere

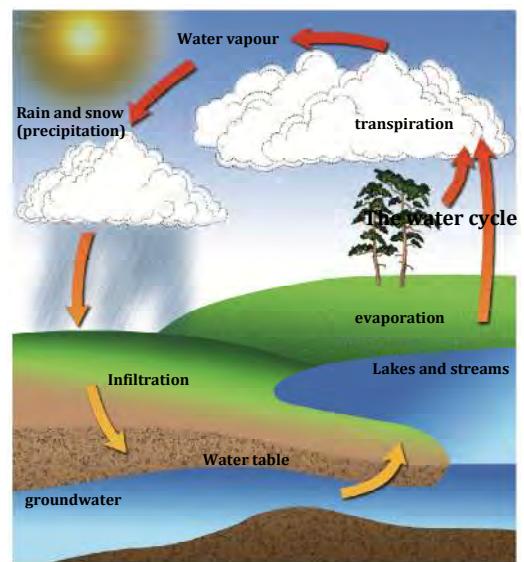
3.2 Evaporation and condensation

3.2.1 The water cycle: evaporation, condensation and precipitation

The hydrological cycle describes the journey of water as water molecules make their way from the Earth's surface to the atmosphere, and back again. This gigantic system, powered by energy from the Sun, is a continuous exchange of moisture between the oceans, the atmosphere, and the land.

3.2.2 How do we interfere with the water cycle?

It happens when we consume huge amounts of fresh water and use up underwater supplies.



- When we clear land of vegetation to build roads and parking areas, we minimise water soaking into the ground.
- When there is more water on the surface, the possibility of flash floods increases, surface runoff is greater, and it can lead to soil erosion.

3.3 Humidity

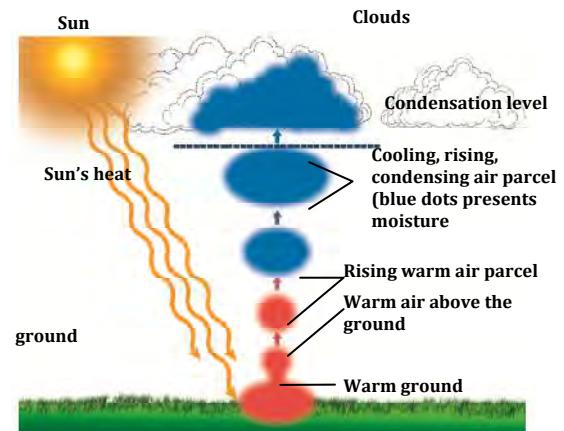
What is humidity and how does it relate to the term 'relative humidity'?

- Humidity simply means that the air contains water.
- Relative humidity, the term most often used, refers to the amount of water vapour that exists in a gaseous mixture of air and water vapour. It is the ratio of the amount of water in the air at a given temperature relative to the maximum amount it could hold at that temperature.
- A wet and dry bulb thermometer is used to measure humidity, which is written as a percentage.

3.4 Clouds

3.4.1 What are clouds and how are they formed?

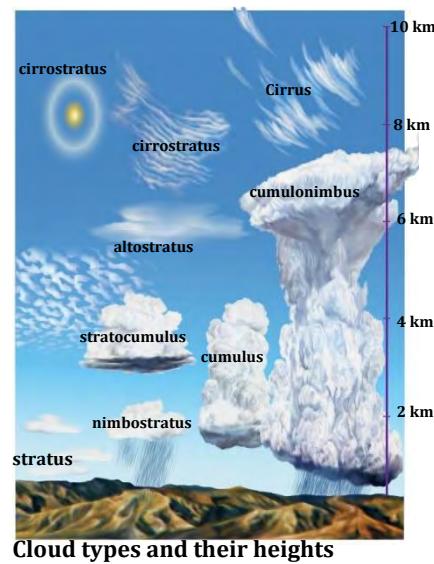
- Clouds are large collections of tiny water droplets or ice crystals.
- In the diagram you can see as warm air rises, it starts to cool. Water vapour condenses around condensation nuclei (like dust, smoke, soot).
- Clouds are formed when condensation takes place – when the dew-point temperature is reached.
- Precipitation forms when air becomes oversaturated.



Moisture in the atmosphere

3.4.2 How are clouds named and what are the associated weather conditions?

Cloud type	Characteristics (height)	Weather
Cumulo-nimbus	Tall (8-10 km), dark grey, strong air currents	Summer rain – thunderstorms
Cirrus	Thin, wispy (thin lines), 8 km and above, point in the direction of the wind blowing	No precipitation, indication of a cold front
Cumulus	Big cotton wool balls, clear sky in between – can develop into cumulonimbus in summer and spring	Can create rain/hail
Stratus	Flat, hazy, featureless, at low altitudes, vary in colour from dark grey to white	May produce drizzle



3.5 Precipitation

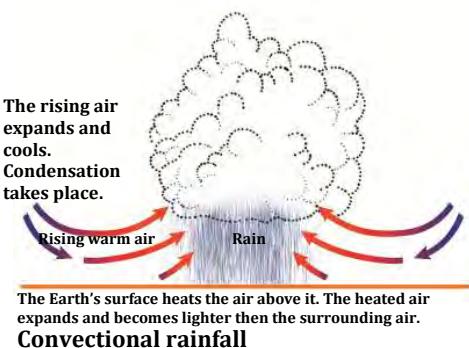
What are the different forms of precipitation? Precipitation is any form of water particle, liquid or solid, that falls from the atmosphere and reaches the ground.

Form	Formation process
Dew	Forms when water vapour condenses onto the ground.
Frost	Forms when dew freezes or when the dew point temperature is below 0°C.
Hail	Forms in cumulonimbus clouds. Water droplets freeze and are taken up into the top of the cloud by strong up-draughts. The droplets fall when the up-draught slows and they are carried up by further up-draughts. Eventually they are too heavy to be held aloft and they fall as hail.
Snow	Forms when temperatures are below freezing in clouds. Water droplets freeze and form tiny ice crystals. These attract other crystals and form snowflakes. When they are heavy enough they fall out of the clouds as snow. If the temperatures are above freezing close to the ground then the flakes will melt and rain will fall. If temperatures remain below freezing then snow will fall onto the ground.
Rain	Forms when the air is saturated, condensation nuclei are available, and the temperature cools to dew point or below.

Moisture in the atmosphere

3.6 Mechanisms that produce different kinds of rainfall

For rain to form, warm air with enough moisture needs to cool down to dew-point temperature (that is the temperature at which water vapour changes to water droplets or dew). Different mechanisms in nature help to create lift in rising moist air so that it can cool down and eventually produce different types of rain.

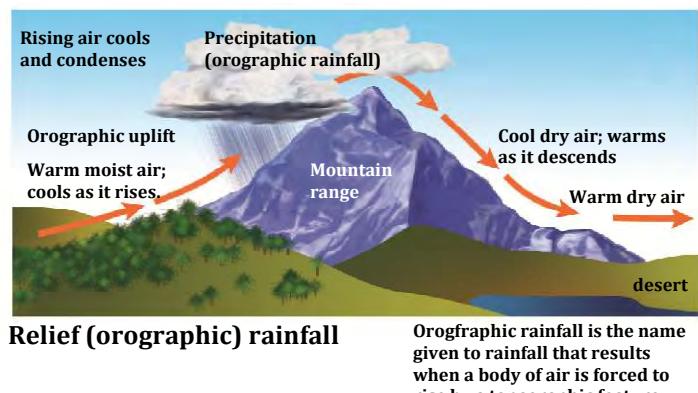


3.6.1 What is convectional rain?

- Occurs when there is intense heating of the Earth's surface especially during summer.
- Evaporation takes place and moist air rises and cools.
- Convectional rain occurs in areas with high temperatures.
- Common in summer rainfall areas in the South African interior.

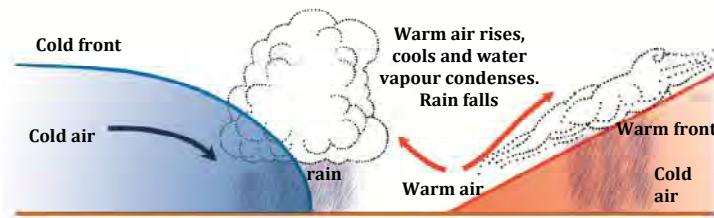
3.6.2 What is relief or orographic rain?

- Occurs in coastal areas that have hills or mountains.
- Wet, onshore winds from the sea are forced to rise and cool against the mountain.
- When the air cools to its dew point, condensation occurs.
- Relief rain falls on the sea-facing mountain side.
- The other (lee) side is drier.



3.6.3 What is cyclonic or frontal rain?

- Cyclonic rain occurs when warm moist air from the frontal system rises over colder air.
- Warm air rises, cools and condenses and frontal rain falls.
- Common over the Western and Southern Cape, especially during winter months.



Synoptic weather maps

Unit 4 Reading and interpreting synoptic weather maps

4.1 What are synoptic weather maps and why are they important?

- Synoptic weather maps offer a summary of weather conditions over a country over a particular period of time.
- They can be used to predict weather and issue warnings.
- Weather stations on the map give information of the weather elements – temperature, dew point temperature, cloud cover, wind direction, wind speed and atmospheric pressure.
- By collecting weather information over a large area, meteorologists can observe the behaviour and movement of weather formations that might affect a region, now and in the future.
- Common symbols used on synoptic weather maps are illustrated below.

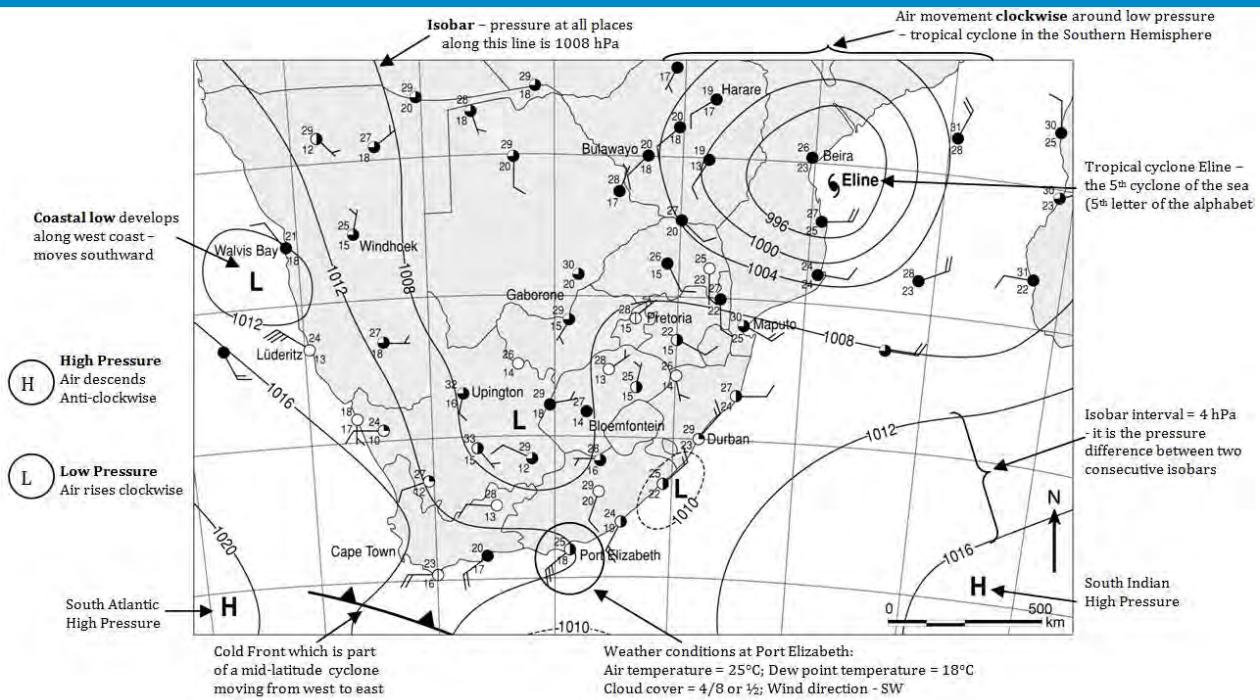
4.2 What are the symbols used on South African synoptic weather maps?

- The date on a synoptic map will tell you the season.
- The isobars indicate the air pressure along that specific line.
- Closely spaced isobars indicate a strong pressure gradient and consequently strong winds. Where isobars are spaced far from each other, it indicates a weak pressure gradient – which means calm to less windy conditions.
- Some isobars form circle-like patterns, which indicate cells of either high or low pressure. We determine the type of pressure cell by looking at the increase (high) or decrease (low) of air pressure towards the centre of the pressure cell.

KEY	
TT	air temperature
WW	deew point
T _A T _A	The arrow flies with the wind Each feather represents 10 knots
1/8	CLOUD AMOUNT
1/4	
1/2	
3/4	
overcast	
ww	PRESENT WEATHER
ww]	WEATHER AT THE STATION DURING THE PRECEDING HOUR BUT NOT AT THE TIME OF OBSERVATION
<	Lightning visible
•	Precipitation within sight
(R)	Thunderstorm without precipitation at time of observation
D	Duststorm
≡	Fog
,	Drizzle
●	Rain
*	Snow
▽	Showers
R	Thunderstorm
AUTOMATIC WEATHER STATION	△
Isobars at MSL in 4 hPa intervals	—
OBSURED SKY	⊗
Isobars at MSL in 2 hPa intervals	- - -

Symbols used on South African synoptic weather maps

Synoptic weather maps



4.3 How are satellite images used by meteorologists?

Meteorologists use satellites to measure our weather from space. Satellite images cover large areas and on a continuous basis. This provides meteorologists with better data and information to do more accurate weather forecasts and predictions. The different wavelengths of radiation that these satellites study provide us with images that illustrate different atmospheric and weather features.

The *visible range of the spectrum* gives us information about:

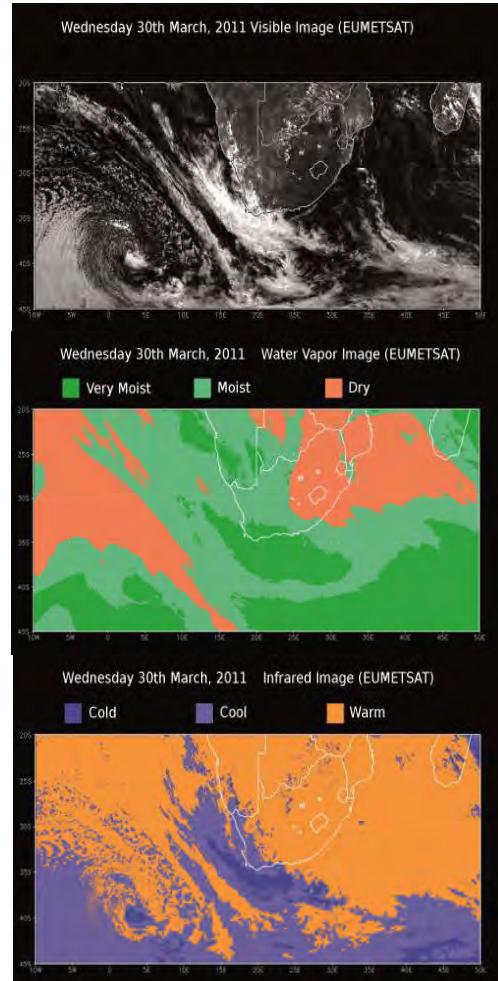
- Cold fronts and general cloud structure
- Cloud bands and thunderstorms over the SA interior
- Effects of the Southeaster on the West Coast.

The *water vapour range of the spectrum* shows the distribution of water vapour in the atmosphere. It gives us information about:

- Frontal systems
- Moisture sources
- The movement of clouds.

The *infrared range of the spectrum* gives us information about:

- Cloud formation at night
- Regions of cold, cool and warm air
- Temperature contrasts such as hot deserts and cool coasts.



The atmosphere

Questions

Question 1

Refer to the source below and answer the questions that follow, for 50 marks.

SOURCE: THE SUNDAY TIMES, Page 2, 24 July 2011

TODAY'S WEATHER

The weather bureau has issued a flood of warnings, watches and advisories for the next few days, which include notice of gale-force winds and rough seas in places between Cape Columbine and Cape Agulhas today, as well as heavy rains in the Overberg and Eden Districts of the Western Cape and the southern parts of the Eastern Cape.

There will be moderate to heavy snowfalls in the Eastern Cape mountains tonight, spreading to the high ground and Lesotho tomorrow. Unsurprisingly, it will be very cold in the Eastern Cape and southern Free State on Monday, with snow expected on the southwestern high ground of KwaZulu-Natal tomorrow and Tuesday.

The south and west of North West and the Highveld and Escarpment of Mpumalanga could possibly be very cold on Tuesday, the bureau has said.

TEMPERATURE FORECAST



KEY	
Sunny/warm	Partly cloudy
Cloudy	Cloudy with rain
Thunderstorms	Snow
Wind direction and speed	Fog

TIDES		
	High/Low	High/Low
Durban	0906/1511	2204/0305
East London	0917/1518	2221/0317
Cape Town	0938/1543	2213/0325
Hermanus	0931/1540	2209/0325
Knysna	0930/1534	2234/0331
Mossel Bay	0917/1522	2222/0320
Port Elizabeth	0923/1527	2223/0320
Port Nolloth	0944/1539	2213/0318
Richards Bay	0904/1511	2158/0300
Saldanha Bay	0934/1538	2208/0320
Simon's Town	0930/1537	2211/0321
Walvis Bay	1017/1632	2236/0337

- 1.1 State the season that South Africa is experiencing? Provide evidence – at least three reasons from the source. $2+(3\times 2)=8$
- 1.2 Is rainfall in the Western Cape typical during this season? Explain. $2+(2\times 2)=6$
- 1.3 Identify the type of rain that the Western Cape is most likely to experience. Provide a labelled sketch of this type of rainfall. $2+(6\times 1)=8$
- 1.4 Look at the temperature graphs for Durban and Cape Town. Account for the warmer temperatures that are experienced along the east coast during this season. $3\times 2=6$
- 1.5 Account for Durban experiencing a lower temperature range than Johannesburg. $3\times 2=6$
- 1.6 Provide brief weather reports for Richards Bay and Ladysmith. $2(2\times 2)=8$
- 1.7 Identify and explain the possible cloud type, its formation and associated weather at George? $4\times 2=8$

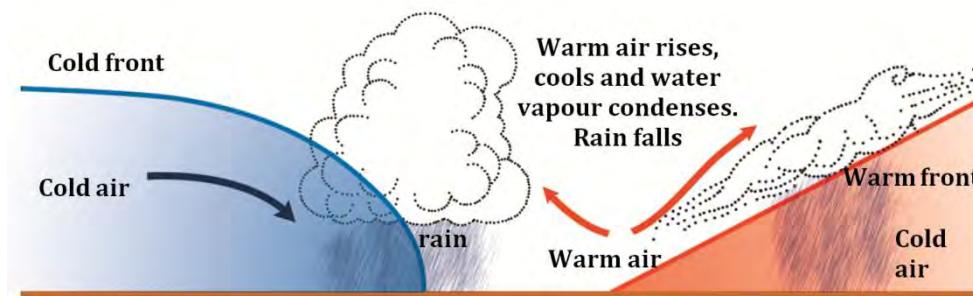
The atmosphere

Answers to Questions

1.1 Winter (2). The date. July is a winter month (2). Colder temperatures observed at night and day throughout the country (2). Snow is being reported over parts of South Africa and winter rain is typical over the Western Cape at this time of the year (2).

1.2 Yes (2). The pressure belts shift northwards with the ‘direct’ rays of the sun (2). Cold polar air brings cold front to the south western part of South Africa, i.e. Western Cape in winter (2), with heavy rainfall along frontal zone when colder polar air forces warm air to rise (2). Western Cape experiences a Mediterranean climate (winter rain).

1.3 Frontal rain (2)



(6×1=6)

1.4 The Agulhas current (2) flows from the equatorial regions (2) bringing warm air to the eastern parts of South Africa (2), therefore Durban has warmer average annual temperature throughout the year. Cape Town along the west coast experiences lower temperatures partly because of the cooling effect of the cold Benguela current coming from the cold polar regions.

1.5 Durban is near the coast (water has a high specific heat) and experiences a maritime climate (2) while Johannesburg is inland (lower specific heat) and experiences a continental climate (2). Therefore Durban has a lower temperature range – cools and heats slower than Johannesburg, which has a higher temperature range (heats and cools quickly) (2).

1.6 Richards Bay is sunny with warm temperatures experienced at night (15°C) and day (25°C) (2) with south easterly off shore winds of 30 km/hour (2). In contrast, Ladysmith is experiencing fog (2) with colder overnight temperatures below 0°C . Daytime temperatures will reach a maximum of 22°C (2).

1.7 Cumulonimbus clouds (2) – South easterly winds are blowing onshore (2) forcing warm air to rise over the escarpment, creating tall clouds characterised by strong vertical air currents – orographic/relief rainfall and thunderstorms result (2). Thus George experiences cold daytime temperatures with thunderstorms (2).

Overview

This section comprises five units. These are the internal structure of the Earth, plate tectonics, folding and faulting, earthquakes, and volcanoes. This section is illustrative, to provide you with concise and relevant information that is well linked. A critical examination of the illustrations and related labels and other information is needed for a complete understanding of the content. These illustrations are enablers to help you to understand critical events and outcomes, like environmental disasters that affect people around the world. Links between key concepts and processes across the five units must be made. The five units are integrally linked and a good understanding of one unit supports an understanding of another unit.

Unit 1 The structure of the Earth

- 1.1 The Earth's structure
- 1.2 The rock cycle
- 1.3 Intrusive igneous activity
- 1.4 Major factors shaping landscapes

Unit 2 Plate tectonics

- 2.1 Continental drift
- 2.2 Plate tectonics

Unit 3 Folding and faulting

- 3.1 Formation of folds
- 3.2 Types of folds
- 3.3 Fold mountains
- 3.4 Faulting

Unit 4 Earthquakes

- 4.1 Formation of earthquakes
- 4.2 Measurement and recording earthquakes
- 4.3 Earthquake waves
- 4.4 Strength of earthquakes

Unit 5 Volcanoes

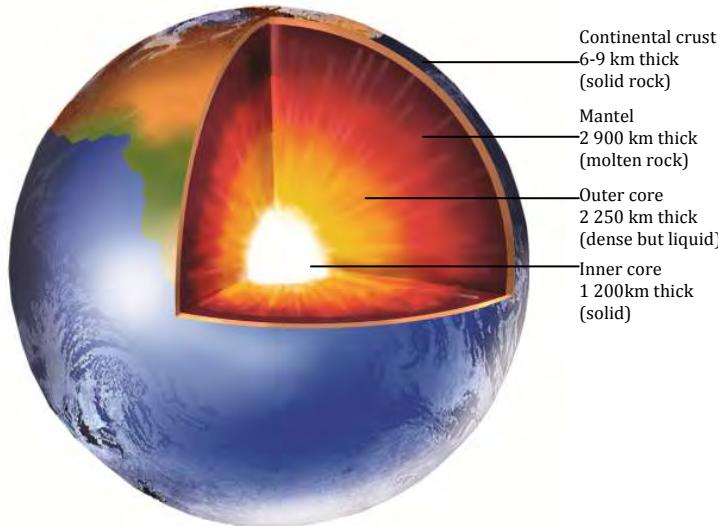
- 5.1 Formation of volcanoes
- 5.2 Classification of volcanoes
- 5.3 Types of volcanoes
- 5.4 Impacts of volcanoes on people

Plate tectonics

Unit 1 The structure of the Earth

1.1 The Earth's structure

- All three forms of matter – solids, liquids and gases – make up the Earth.
- The Earth is made up of four distinct layers; a solid outer crust, a solid mantle, a liquid outer core and a solid inner core.
- The Earth is 4,56 billion years old.



The structure of the Earth

1.1.1 Continental crust

- The crust is the outermost layer of solid rock, on which we live. It is thicker under the continents and thinner under the oceans.
- The lithosphere consists of the crust and the solid top part of the mantle.
- The crust is broken into smaller segments, called plates, which float on the mantle.
- The crust is 6-90 km thick (solid rock).
- The temperature increases with depth.

1.1.2 Mantle

- The mantle is beneath the crust.
- It is 2 900 km thick, consisting of hot and plastic but solid rock. Temperatures may reach 5 000°C.
- The Moho discontinuity is the boundary between the crust and the mantle.

1.1.3 Outer core

- The outer core layer is very dense but liquid due to extremely high temperatures.
- It is 2 250 km thick.
- It consists of nickel (Ni) and iron (Fe). Known as NiFe.

1.1.4 Inner core

- The inner core is extremely hot.
- It is solid because of extreme pressure.
- It is 1 200 km thick.

Plate tectonics

1.2 The rock cycle

- The rocks in the crust of the Earth are always changing. Rocks change when they are heated and subjected to pressure deep underground.
- The Earth's moving crust is twisted and squeezed by pressures within the Earth.
- On the Earth's surface rocks are broken down by water, wind and ice (weathering) and destroyed by erosion.

The ongoing process of making, breaking down and remaking any one type of rock to recreate another type is called the rock cycle.

1.2.1 Processes that change rocks in the rock cycle

- Pressure and temperature turn sedimentary rocks into igneous rocks.
- Pressure and temperature turn igneous rocks into metamorphic rocks.
- Temperature turns sedimentary rocks into metamorphic rocks.
- Weathering turns metamorphic rocks into sedimentary rock.

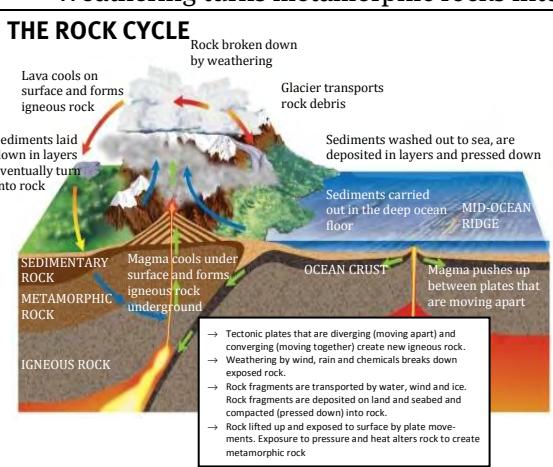
 <p>THE ROCK CYCLE</p> <p>Rock broken down by weathering</p> <p>Lava cools on surface and forms igneous rock</p> <p>Sediments laid down in layers eventually turn into rock</p> <p>Magma cools under surface and forms igneous rock underground</p> <p>Glacier transports rock debris</p> <p>Sediments washed out to sea, are deposited in layers and pressed down</p> <p>Sediments carried out in the deep ocean</p> <p>MID-OCEAN RIDGE</p> <p>OCEAN CRUST</p> <p>Magma pushes up between plates that are moving apart</p> <p>→ Tectonic plates that are diverging (moving apart) and converging (moving together) create new igneous rock. → Weathering by wind, rain and chemicals breaks down exposed rock. → Rock fragments are transported by water, wind and ice. Rock fragments are deposited on land and seabed and compacted (pressed down) into rock. → Rock lifted up and exposed to surface by plate movements. Exposure to pressure and heat alters rock to create metamorphic rock</p>	<p>UPPER CRUST - SEDIMENTARY ROCK</p> <ul style="list-style-type: none"> Sediments deposited by wind, water and ice build up in layers. Older layers are squeezed under the weight from above and become solid rock. <table border="1" data-bbox="770 1123 1309 1313"> <tbody> <tr> <td data-bbox="770 1123 935 1246">  Conglomerate Formed from large pebbles </td><td data-bbox="935 1123 1159 1246">  Limestone Consolidated seashells </td><td data-bbox="1159 1123 1309 1246">  Shale Consolidated clay </td></tr> </tbody> </table>	 Conglomerate Formed from large pebbles	 Limestone Consolidated seashells	 Shale Consolidated clay			
 Conglomerate Formed from large pebbles	 Limestone Consolidated seashells	 Shale Consolidated clay					
<p>CRUST - IGNEOUS ROCK</p> <ul style="list-style-type: none"> Magma rises through the crust, cools and crystallises into new rock. The slower the cooling, the larger the crystals formed in rock. <table border="1" data-bbox="187 1695 748 1909"> <tbody> <tr> <td data-bbox="187 1695 359 1909">  Granite Very hard rock Contains large crystals </td><td data-bbox="359 1695 561 1909">  Obsidian Cools quickly Glassy texture </td><td data-bbox="561 1695 748 1909">  Basalt Dark and fine-grained Most common igneous rock </td></tr> </tbody> </table>	 Granite Very hard rock Contains large crystals	 Obsidian Cools quickly Glassy texture	 Basalt Dark and fine-grained Most common igneous rock	<p>DEEPER CRUST – METAMORPHIC ROCK</p> <ul style="list-style-type: none"> Igneous and sedimentary change by heat and pressure. <table border="1" data-bbox="770 1617 1309 1819"> <tbody> <tr> <td data-bbox="770 1617 935 1819">  Gneiss Changed granite </td><td data-bbox="935 1617 1159 1819">  Marble Changes limestone and dolomite </td><td data-bbox="1159 1617 1309 1819">  Slate Changed shale </td></tr> </tbody> </table>	 Gneiss Changed granite	 Marble Changes limestone and dolomite	 Slate Changed shale
 Granite Very hard rock Contains large crystals	 Obsidian Cools quickly Glassy texture	 Basalt Dark and fine-grained Most common igneous rock					
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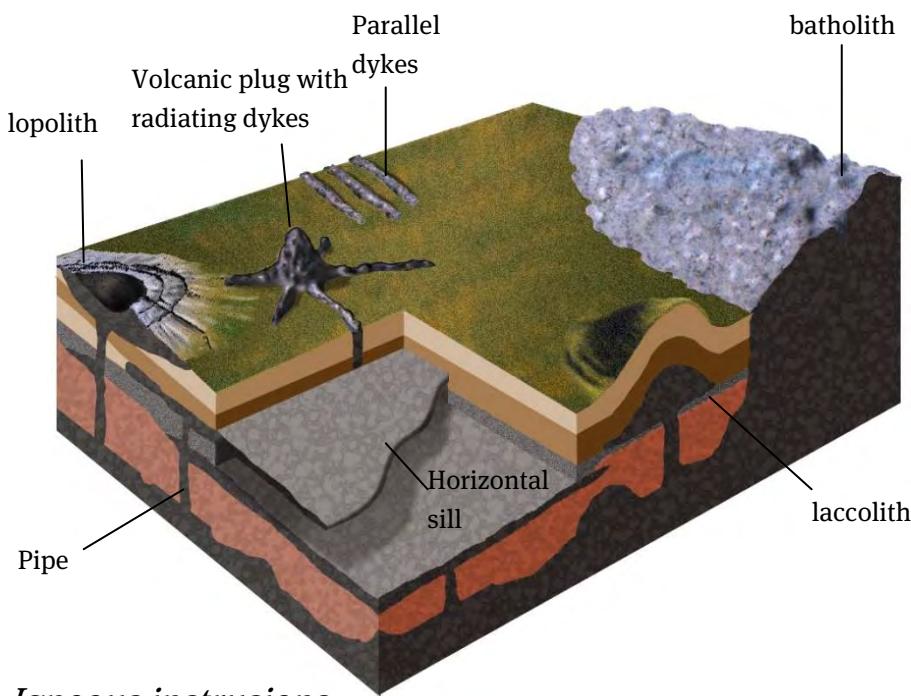
Plate tectonics

1.3 Intrusive igneous activity

- Magma can form igneous rock either by erupting on the Earth's surface as lava, or by solidifying as a mass underground.
- Intrusive igneous activity occurs when the magma intrudes into spaces underground and hardens. Granite is a common type of igneous rock that is formed in this way.

1.3.1 What landforms are associated with intrusive igneous activity?

Intrusive bodies such as *batholiths*, *laccoliths*, *lopoliths*, *pipes*, *dykes* and *sills* are formed by intrusive igneous activity. They are exposed on the Earth's surface only after millions of years.



Igneous intrusions

Batholiths

- Largest intrusive form – formed when an enormous mass of magma pushes upwards and solidifies under Earth's surface.
- Usually made of granite – exposed on the surface by erosion – removal of weathered rock by wind/water/ice. Example: Paarl Mountain in the Western Cape

Laccoliths and lopoliths

- A laccolith is formed when magma intrudes between older layers of sedimentary rocks, pushing the overlying strata upwards in the shape of a mushroom.
- When magma intrudes between horizontal sedimentary layers and the layer beneath collapses, a saucer-shaped intrusion, called a lopolith forms.
- Smaller than batholiths – not formed as deep in the Earth's crust.
- Both are connected to the magma source by means of a dyke or pipe. Example: Bushveld Igneous Complex

Plate tectonics

Pipes, dykes and sills – often made of dolerite

- Pipe – a chimney-shaped intrusion, magma moves up the pipe to the surface.
 - Dykes and sills – formed when magma solidifies in thin horizontal or vertical sheets.
 - Dyke – wall-like intrusion – cuts vertically across rock layers.
 - Sill – forms when magma spreads horizontally between layers.
 - Dykes often visible as narrow exposed ridges.
 - Sills visible as cap rock of mesas (flat top mountains) and buttes (flat-topped hills).
- Example: Flat-topped Karoo hills

1.4 Major factors shaping landscapes

- Resistance to erosion – Harder rocks are more resistant to erosion.
- Permeability of rocks – Impermeable rocks do not allow water to pass through them.

1.4.1 Sedimentary rock landforms

- Karst landforms – formed in limestone.
- Consists of caves, springs and aquifers.
- Rock permeability and chemical weathering are key factors.

1.4.2 Igneous rock landforms

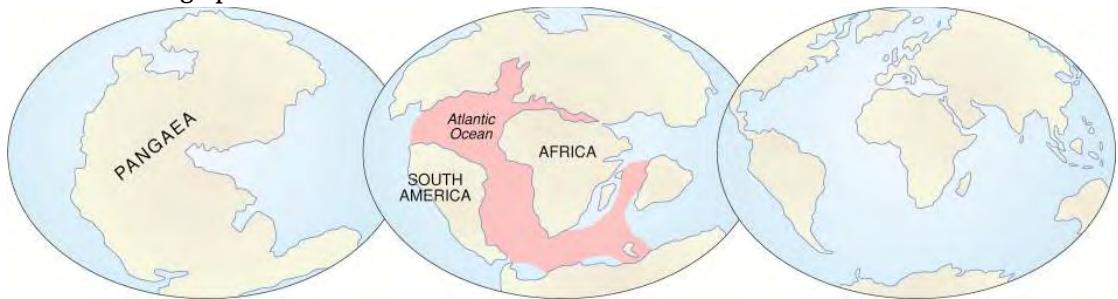
- A tor is a typical granite landform.
- Formed when joints and cracks in the granite are weathered under the surface of the ground. Remaining core-stones eventually exposed through erosion of the surrounding material.
- Whalebacks are exposed batholiths.

Plate tectonics

Unit 2 Plate tectonics

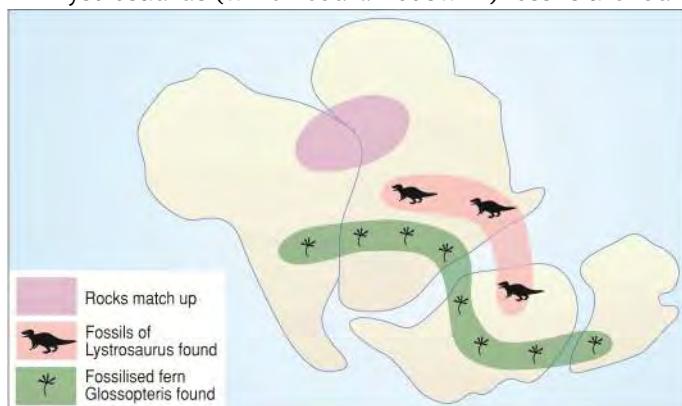
2.1 Continental drift

- In 1923 Alfred Wegener suggested that the continents were drifting.
- Today it is believed that 200 million years ago a super continent, which comprised all continents, existed. Geologists call it Pangaea.
- 135 million years ago Pangaea split into Laurasia (the northern continent) and Gondwana (the southern continent).
- Subsequently, these two continents also split up to form today's continents, which are still moving apart.



2.1.1 Evidence supporting the movement of continents over time

- The east coast of South America fits the west coast of Africa almost perfectly at 2 000 m below sea level, except for geologically recent submarine deltas like the Niger and Orange River.
- Geology and fossils of Africa and South America are similar.
- Glacial deposits in Brazil match those in West Africa.
- Rock formations along South Africa's west coastline match those along South America's east coastline.
- Similar coal deposits are found in the same stratigraphic positions in Antarctica, South America, India, Africa and Australia
- Lystrosaurus (which could not swim) fossils are found in Africa, India and Antarctica.



Evidence of continental drift

Plate tectonics

2.2 Plate tectonics

The Earth is divided into a series of plates which fit together like a jigsaw puzzle and float on the plastic rock of the upper mantle. They move at various rates, up to 30 cm per year, because convection currents in the solid (but putty-like) mantle push them in different directions.

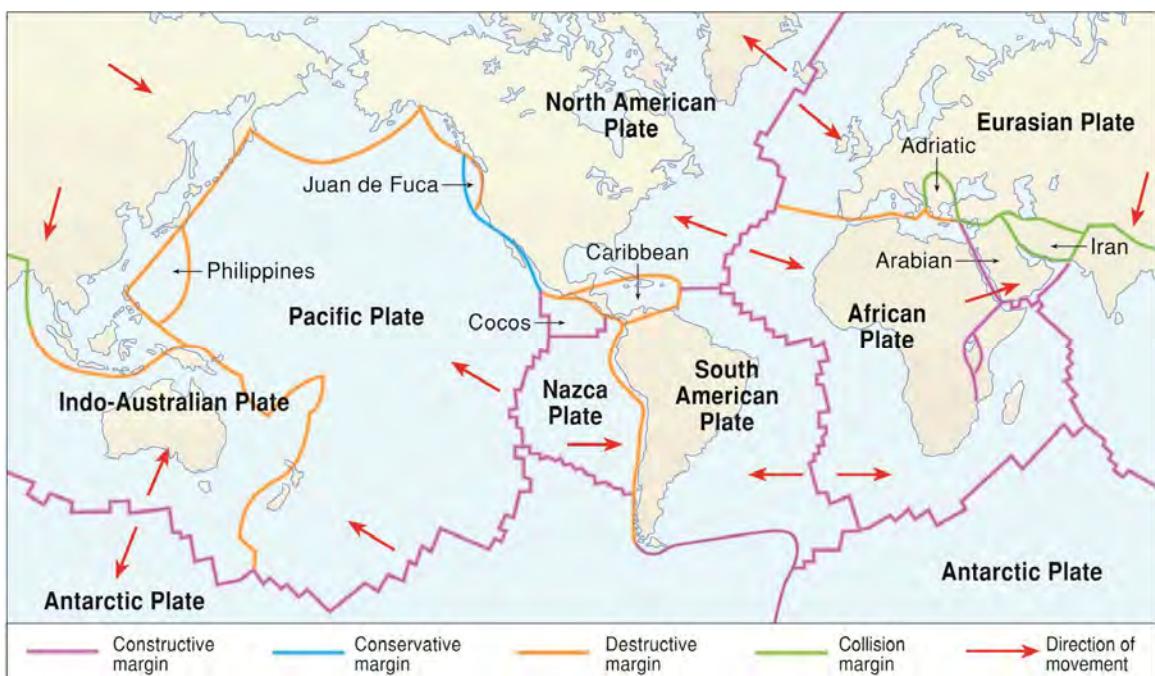


Plate tectonics

2.2.1 Plate margins

Various types of margins – namely destructive, constructive, conservative and collision margins – form at plate boundaries, depending on the movement of the plates at that boundary. These four margins and their formation are illustrated in the table below.

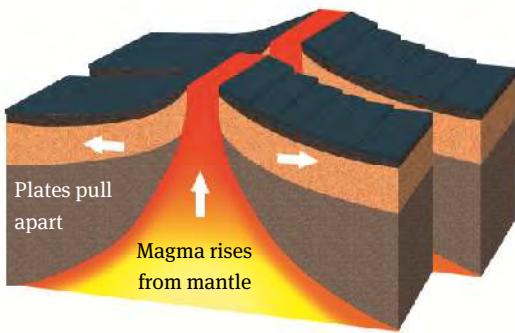
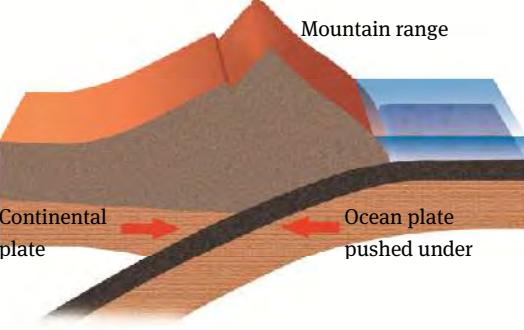
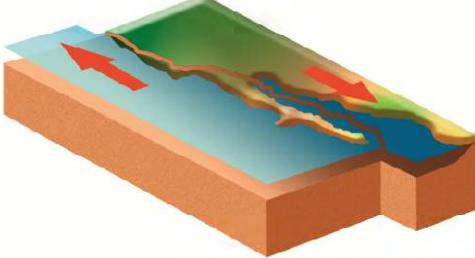
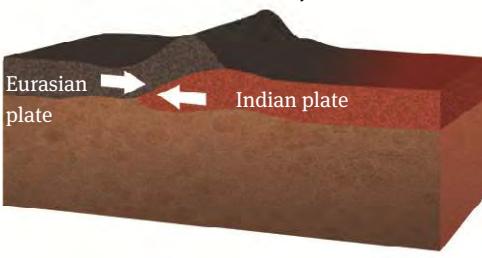
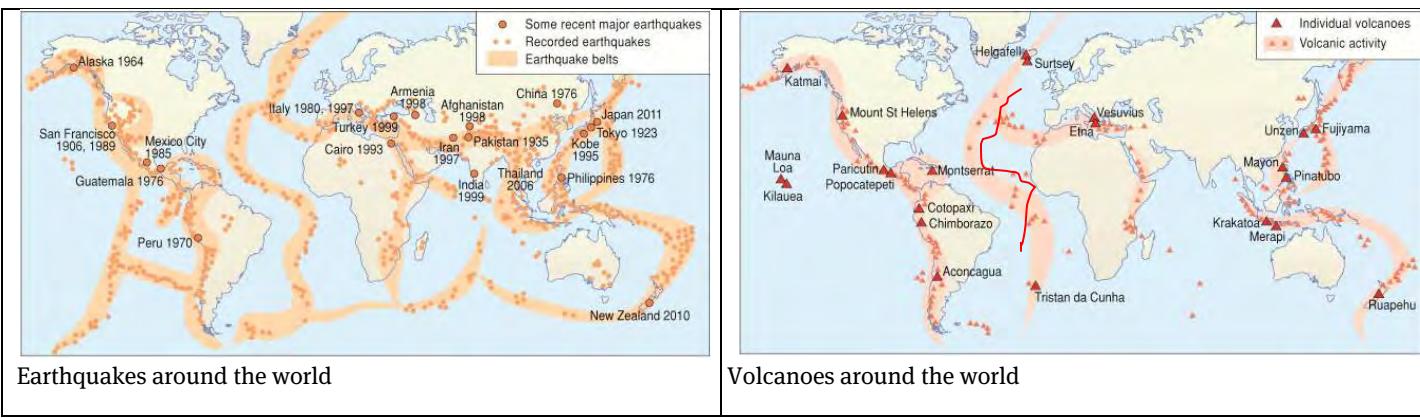
 <p>Plates pull apart Magma rises from mantle</p>	CONSTRUCTIVE MARGINS Two plates move away from one another. Molten rock (magma) rises to fill the space. New oceanic crust and mid-ocean ridges form. Gentle volcanoes and earthquakes. Example: Mid Atlantic Ridge
 <p>Mountain range Continental plate Ocean plate pushed under</p>	DESTRUCTIVE MARGINS Ocean crust moves towards continental crust. Ocean crust sinks. Deep-sea trenches and volcanic islands arcs (a string of islands) occur. Can trigger violent earthquakes and violent volcanic eruptions. Example: Japan
	CONSERVATIVE MARGINS Two plates slide past each other slowly. No crust is formed or destroyed. If the plates stick, pressure builds up and severe earthquakes result, moving the plates again. There are no volcanic eruptions. Example: San Andreas fault in California
 <p>Himalayas formed Eurasian plate Indian plate</p>	COLLISION MARGINS Two plates consisting of continental crust collide. Rocks between the plates are forced upward to form fold mountains. Can cause strong earthquakes. No volcanoes. Example: Himalayas

Plate tectonics

2.2.2 The world's volcanic and earthquake zones

- Note that belt of earthquakes occurs where plates are moving apart – North and South American plates on the left and African plate on the right.
- A belt of volcanoes is also evident in this region.



Predictability of earthquakes

- Signs like tremors need to be heeded.
- Use instruments that record the tension in rocks and estimate earthquake risk.
- Landform shape changes can inform.
- Animal behaviour can inform.
- Receding coastal shorelines can inform.

Reducing impact of earthquakes

- Locate active fault zones using surveys.
- Identify high-risk areas.
- Ensure effective emergency facilities.
- Strengthen infrastructure (roads, homes).
- Tsunami warnings in applicable areas.

Predictability of volcanoes

- Ground temperatures can increase.
- Volcanoes emit gas and steam.
- Rising magma can cause volcanoes to bulge.
- Tilt meters can measure slope changes of volcanoes.

Preparing for volcanic eruptions

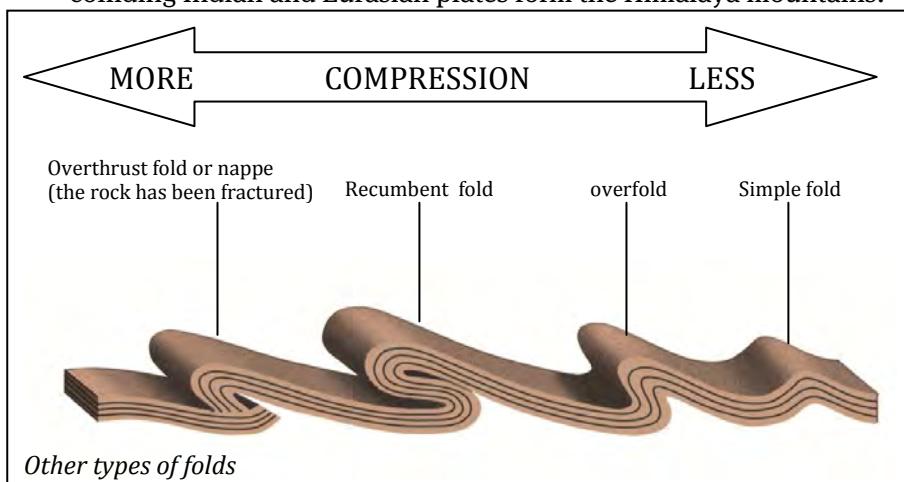
- Monitoring and warning systems, evacuations, efficient emergency systems/services (medical, water, food).

Folding and faulting

Unit 3 Folding and faulting

3.1 Formation of folds

- Sediments laid down in horizontal layers form sedimentary rocks.
- Folds form when tectonic plates push together, placing the rock layers under tremendous pressure.
- The rock layers compress and form fold features. These range from simple folds to heavily compressed folds, which also feature fractured rock.
- Fold mountains are normally formed on the edges of colliding plates. For instance, the colliding Indian and Eurasian plates form the Himalaya mountains.



3.2 Types of folds

3.2.1 Overthrust fold

- Also called a Nappe.
- Pressure is very great.
- Fold breaks/fractures – faulting occurs.
- One limb is pushed forward over the other limb.

3.2.2 Recumbent fold

- Occurs under extreme pressure.
- Result is the limbs become nearly horizontal.

3.2.3 Overfold

- Similar to an anticline fold.
- Except that the one limb is more steeply inclined than the other.

3.2.4 Monocline

- Is the simplest fold.
- Step-like fold in rock strata.
- Consists of an area of steeply sloping rock strata in an area of otherwise gently sloping rock strata.

Folding and faulting

3.2.5 Syncline and anticline

- A syncline fold is where rock layers fold downwards in a U shape.
- An anticline fold is where rock layers fold upward in a M shape.

3.3 Fold mountains

Famous fold mountains

Alps, Rockies, Himalayas, Cape Fold Belt mountains in South Africa, Atlas in north Africa, Mount Everest (8 850 m above sea level).

South Africa's fold mountain treasure

Cape Fold Belt mountains – 23 ranges. Highest peak 2 325 m above sea level. Older than the Alps and Himalayas.

Effects of mountains on people

- Often sparsely populated.
- Cattle, sheep and goat farming is suitable for mountainous areas. In the foothills crops can be grown – terrace farming.
- Tourism is popular in fold mountains, for instance, in the Alps, Rockies, Himalayas and Andes – eco-tourism, cultural tourism, photography, skiing and relaxation activities.
- Forestry – deforestation results in soil erosion.
- Steep slopes with fast flowing rivers – hydroelectric power.

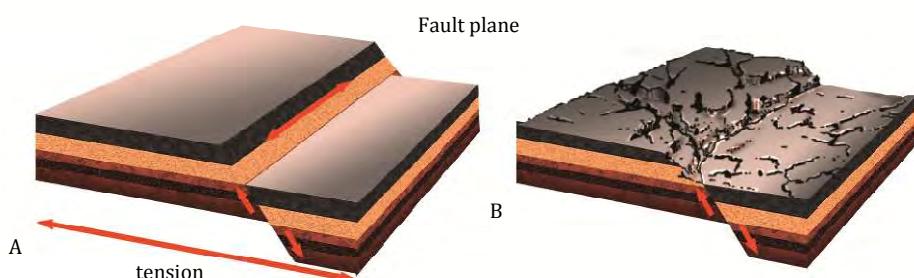
3.4 Faulting

3.4.1 Cause of faults

- Under great pressure, rocks can crack or fracture.
- One section of rock may then slide alongside or over another. The fracture is called a fault.
- Faulting can be caused by either lateral (sideways) or vertical (up and down) forces.
- The forces may be caused by tension (rock layers being stretched or pulled apart) or compression (the rocks being squeezed or pushed together).
- A normal fault is caused by tension.
- If one part of the crust is being compressed then another part is under tension (being stretched).
- Rocks under tension usually fault.
- Rocks under compression may fault or fold – softer rocks will fold, but harder rocks that are brittle, will fault.

Folding and faulting

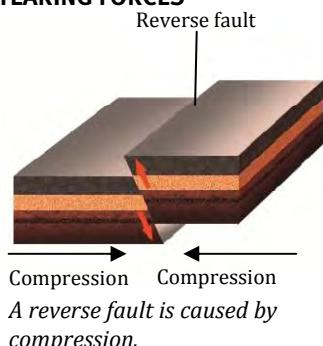
NORMAL FAULTS



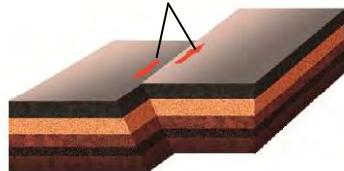
A normal fault is caused by tension (A). This is how the area looks after erosion has taken place (B)

REVERSE FAULTS AND LATERAL

TEARING FORCES



Internal forces



LANDFORMS ASSOCIATED WITH FAULTS

- Earth movements sometimes cause rectangular-shaped blocks of rock to be pushed up or down.
- Results in block mountains (horsts) and rift valleys (grabens).

BLOCK MOUNTAINS

- Tourist attractions.
- Often sparsely populated.
- Can provide site of protection, lookouts, forts.

RIFT VALLEYS

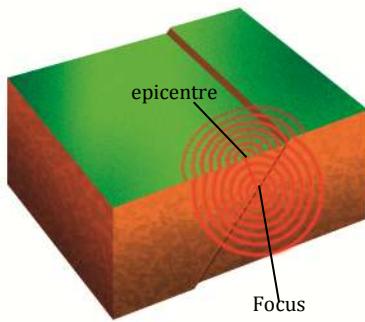
- Steep sides called fault scarps.
- Eroding highlands make the valley fertile.
- Buried sediments – preserves fossils.
- Scenic for tourists.
- Example: East African Rift valley

Unit 4 Earthquakes

4.1 Formation of earthquakes

- An earthquake is the sudden, violent shaking of the Earth, caused by the movement of faults.
- When two slabs of crust move against each other or one dives beneath the other, movement on the fault between them produces earthquakes.
- Collapses in mines can also produce.

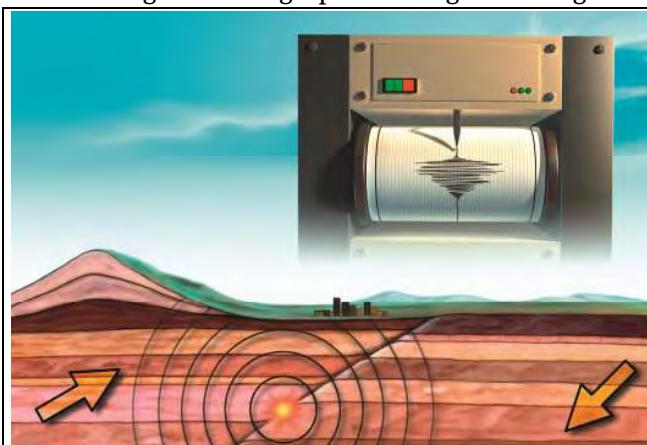
4.2 Measurement and recording earthquakes



- The focus – the point below the surface where the earthquake starts.
- The epicentre – the point on the Earth's surface immediately above the focus.

The focus and epicenter of an earthquake

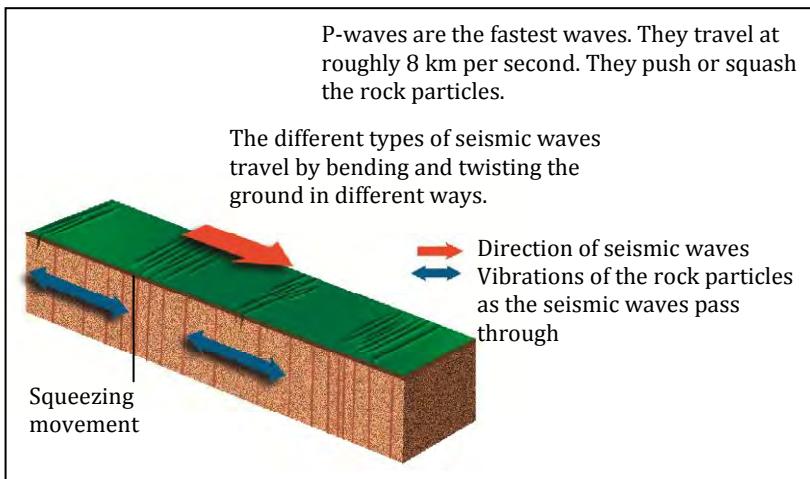
- Seismic or earthquake waves – shock waves which move out from the focus in all directions.
- Seismograph – the instrument which measures seismic waves.
- Seismogram – the graph showing the strength of the seismic waves.



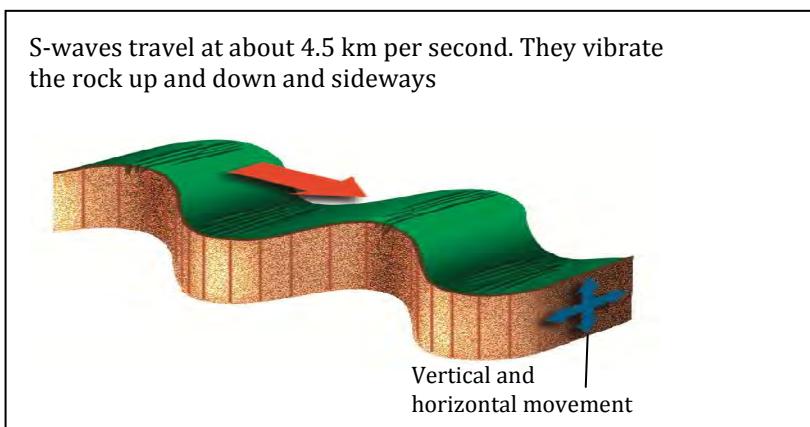
Earthquakes

4.3 Earthquake waves

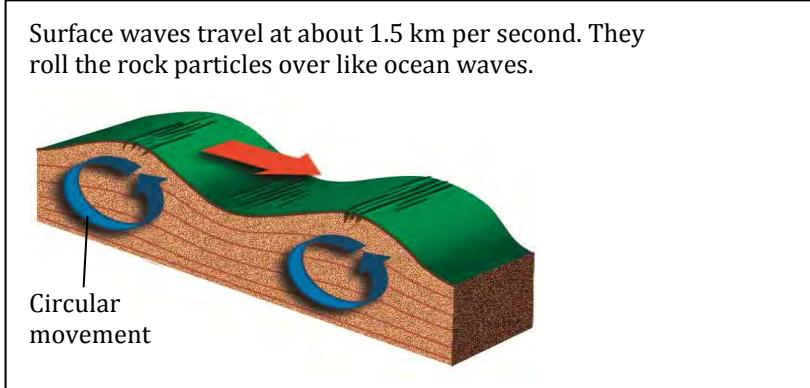
- Primary waves (P-waves) – fastest waves – squeeze and stretch the ground.



- Secondary waves (S-waves) – move the rock up and down and sideways at the same time.



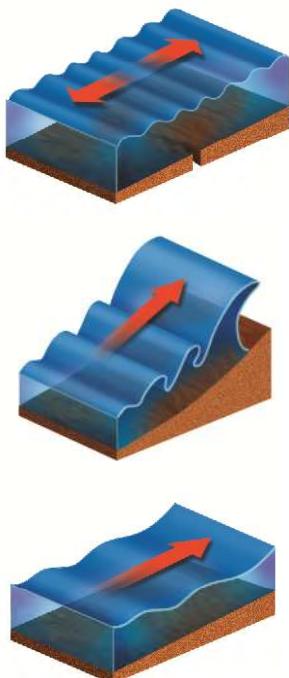
- Surface waves – similar to ocean waves, they roll the rock particles over in circles – in the crust of the Earth.



Earthquakes

4.3.1 Tsunami

A tsunami is a big ocean wave that is created by a strong earthquake, a volcano, undersea slump or a large meteorite that hits the sea or nearby land.



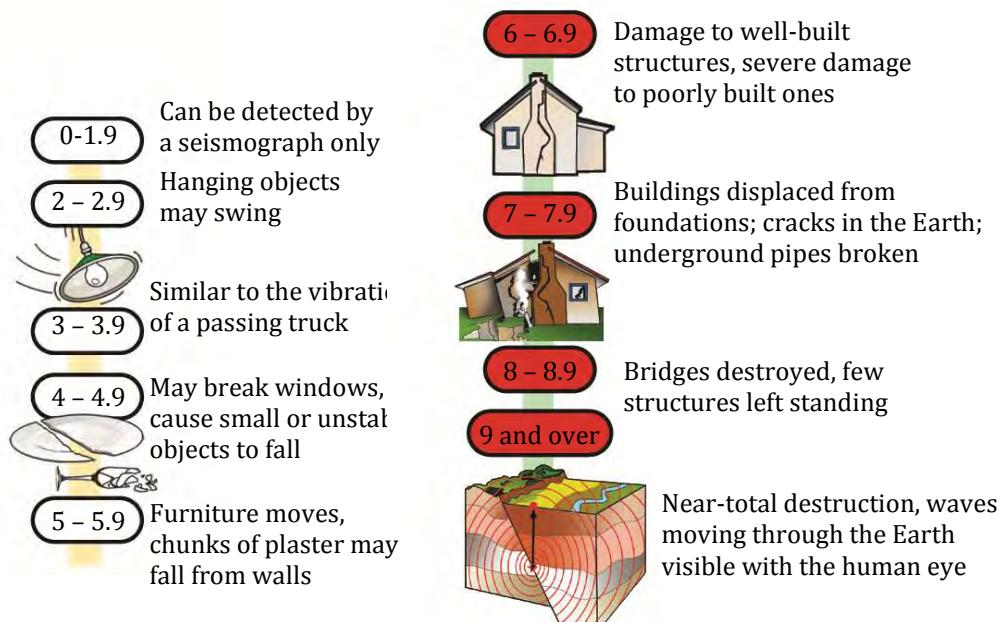
TSUNAMI

- 1 Under-sea earthquake – rise and fall in ocean floor.
- 2 Wave causes sea level to rise.
- 3 Near land, tsunami wave slows down and builds in height. Sea draws back and creates a big wave that speeds onto land.

4.4 Strength of earthquakes

Earthquakes are measured using the Richter scale. It is a logarithmic scale used to measure the energy emitted by earthquakes and to compare the strength of different earthquakes.

Measures energy waves emitted by earthquake



Earthquakes

4.5 Effects of earthquakes

- Electricity, gas and water supplies are disrupted.
- Dam walls may break and cause landslides and mudslides.
- A shortage of fresh drinking water, food and medical supplies result.
- Industries may be forced to close.
- Diseases may break out.
- Near the coast, tsunamis (very large ocean waves) may occur.
- High fatalities in densely populated areas, instant loss.

4.5.1 Why earthquakes have a greater impact on developing countries

Developed countries	Developing countries
Researchers and geologists provide vital information to predict earthquakes.	Under spend on research or complete lack of research.
Construct earthquake-resistant buildings, causing less destruction.	Higher population density, more informal settlements – more deaths.
Better emergency services and medical facilities.	Lack infrastructure and facilities to care for larger population.
Better communication networks – keep people informed and provide early warning signals.	Lack communication infrastructure.
More educated about how to protect themselves when earthquakes strike.	Generally unprepared. People live in high risk disaster zones, because of limited space.

4.5.2 Initiatives in developed countries to prepare for earthquakes

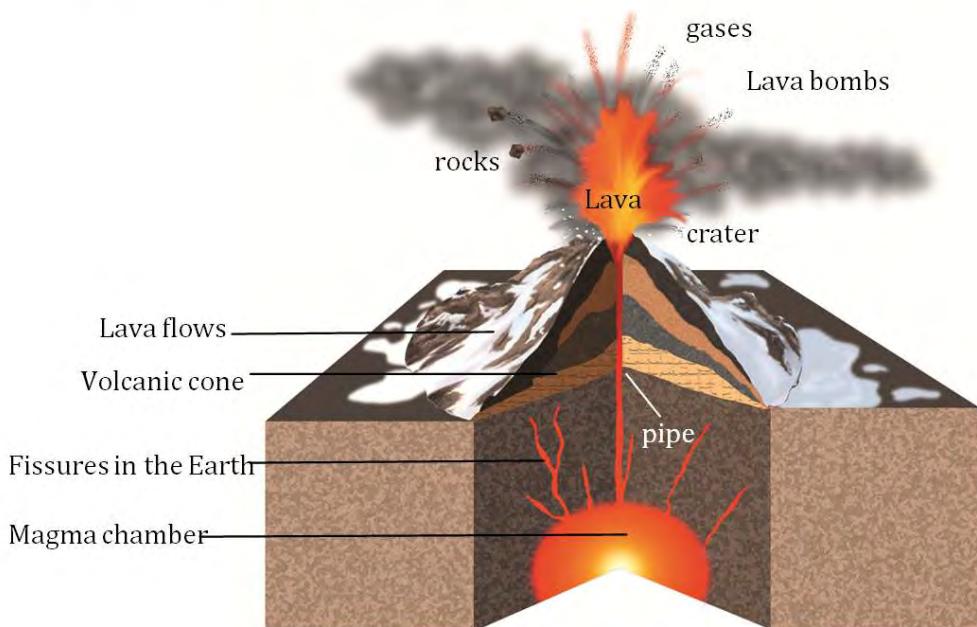
- Search and rescue teams supported by block captains (California).
- Establish a trailer morgue (California).
- Specialists using concrete-cutting chain saws to open holes to save trapped victims.
- Establishment of first aid stations with volunteer doctors and nurses.
- Setting up earthquake warning systems (Japan, Mexico).
- A nation-wide alert system (Japan). California doesn't have one yet.
- Quakeproof utility ducts deep below Tokyo to minimise damage to water, electricity, telephone, and sewage lines.

Volcanoes

Unit 5 Volcanoes

5.1 Formation of volcanoes

Material ejected by volcano



- Volcanoes are formed when molten material (magma), below the Earth's surface, rises through cracks/pipes and forms a magma reservoir/chamber.
- Magma moves through a pipe onto the Earth's surfaces through a vent.
- Molten rock at the Earth's surface is called lava.
- A volcano can have several pipes. Some don't reach the surface.

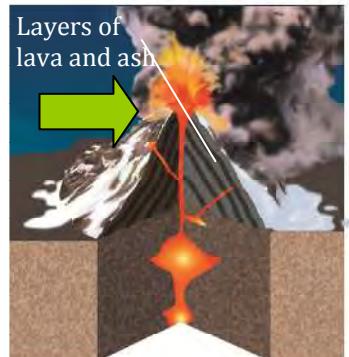
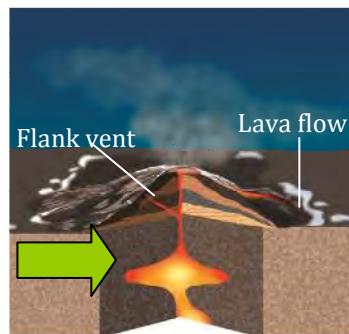
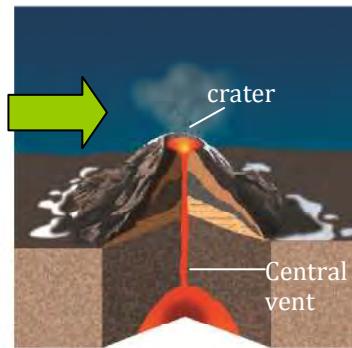
5.2 Classification of volcanoes

- Active – erupt regularly. Example: Anak Krakatau, erupted 2007.
- Dormant – have erupted in recorded history and could do so again. Example: Fujiyama
- Extinct – have never erupted in recorded history and probably will not do so. Example: Mt Kenya

Volcanoes

5.3 Types of volcanoes

- Cinder cones (simplest volcanoes):
Form when eruptions shoot great quantities of ash and particles of glassy lava into the air.
- The particles solidify in the air and rain down around the vent. Conical peaks are steepest. Consist of ash and solid material.
- The eruption is explosive. Lava is limited. Example: Italy's Monte Nuovo
- Shield volcanoes: Form when lava flows out of a central vent.
- The result is gentle slopes of enormous breadth. Bases are dozens of kilometres wide.
- The eruption is not explosive.
- Example: Hawaii's Mauna Loa
- Composite volcanoes: Form when alternating layers of ash, lava and rocks are created by multiple and often explosive eruptions.
- Characterised by a steep-sided conical peak.
- Example: Vesuvius in Italy and Fujiyama in Japan



5.4 Impacts of volcanoes on people

Positive impacts	Negative impacts
Tourist attractions: Caldera, hot springs, geysers.	Can emit dangerous fumes/particles.
Volcanic ash is a good fertilizer.	Ash can pollute water supplies.
Volcanic material forms fertile soil.	Ash can reduce visibility, interfere with aircraft flights.
Diamonds can be found in some old volcanic pipes.	Mud flows can cover settlements.

Geomorphology

Questions

Question 1

Refer to the source below and answer the questions that follow, for 50 marks.

Iceland

The longest range of mountains on Earth, known as the Mid-Atlantic Ridge, are not on land, but lie far below sea-level on the Atlantic Ocean sea-floor, about 4 km down. This undersea range, rising to about 3 000 m above the sea-floor, marks the edge of a still diverging tectonic plate boundary that separates the Eurasian Plate and the North American Plate in the North Atlantic, and the African Plate from the South American Plate in the South Atlantic.

The Mid-Atlantic Ridge runs for over 11 000 km from near Bouvet Island in the South Atlantic, to just south of the Arctic Circle, where it becomes the Reykjanes Ridge, on top of which outcrops the volcanically active island of Iceland. Covering an area of about 103 000 km² and with a population of just 320 000, it is a sparsely inhabited island that is geologically still very active. Here, it is quite possible to stand with one foot on the Eurasian Plate, and another on the North American Plate, which continue to move apart by about 1 cm per year.

Because these plates are divergent, the Earth's crust (the lithosphere) is stretched thin, allowing hot molten rock (magma) from the Earth's core to rise up and heat the Earth's crust. Where this fractures, molten lava may flow through fissures to form active volcanoes that spew fiery eruptions of lava and ash into the sky. And where volcanoes form beneath icecaps, melt-water is turned to steam; adding to the spectacle. Elsewhere, water-filled caverns can become super-heated by the hot magma, leading to spectacular eruptions of water known as geysers. Iceland takes full advantage of this geothermal activity, which is harnessed to provide the country with over 80% of its energy needs. Hot water from underground sources is even run through pipes beneath the roads in the capital city of Reykjavik, creating 'thermal blankets' to keep the roads snow- and ice-free in winter.

The position of Iceland in relation to the Mid-Atlantic Ridge.
Image: Wikimedia commons



Source: Quest 6(2); 2010:44

- 1.1 Is the Mid-Atlantic Ridge at a constructive, destructive, conservative or collision margin? Provide evidence from the source and present a labelled sketch showing what occurs at the margin. (10)
- 1.2 Is the volcano described a shield, composite or cinder volcano? Provide evidence from the source. (4)

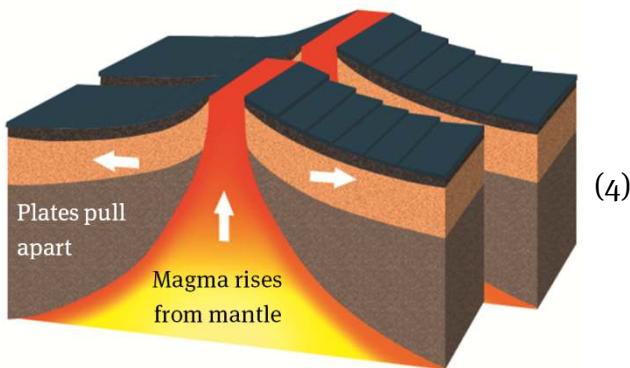
Geomorphology

- 1.3 Provide two characteristics of the other two types of volcanoes? (6)
- 1.4 Identify two positive and two negative factors that volcanic activity has in this region. (8)
- 1.5 Explain the concept of plate tectonics. (4)
- 1.6 What measures should the government consider to safeguard the population of Iceland? Provide any four. (8)
- 1.7 In five years' time, by how much would the Eurasian and North American plates have moved apart? (4)
- 1.8 Are conditions suitable for the formation of fold mountains at the Mid-Atlantic Ridge? Explain your answer. (4)
- 1.9 Distinguish between synclines and anticlines. (2)

Geomorphology

Answers to Questions

- 1.1 Constructive margin (2) Two plates move away from one another. Molten rock (magma) rises to fill the space. New oceanic crust and mid-ocean ridges formed, for instance, Mid Atlantic Ridge as well as volcanic islands such as Iceland. Gentle volcanoes and earthquakes. (4)



- 1.2 Composite – fiery eruptions of ash and lava (4).

- 1.3 Shield volcanoes: Form when lava flows out from a central vent. The result is gentle slopes of enormous breadth - wide base. The eruption is not explosive (3). Cinder cones (simplest volcanoes): Form when eruptions shoot great quantities of ash and particles of glassy lava into the air. The particles solidify in the air and rain down around the vent. Conical peaks – steepest – of ash and solid material are created (3).

- 1.4 Positive – Tourist attraction – source of income, geysers providing geothermal energy – 80% of some areas' energy needs (4). Negative – People have to relocate during life threatening or health threatening eruptions. Can disrupt economic activity (4).

- 1.5 The Earth is divided into a series of plates that fit together like a jigsaw puzzle and float on the plastic upper mantle (2). They move at various rates up to 30 cm per year because convection currents in the mantle push them in different directions (2).

- 1.6 Monitoring and warning systems, evacuation plans, efficient emergency systems/services (medical, water, food) (6). Installation of tilt meters (2).

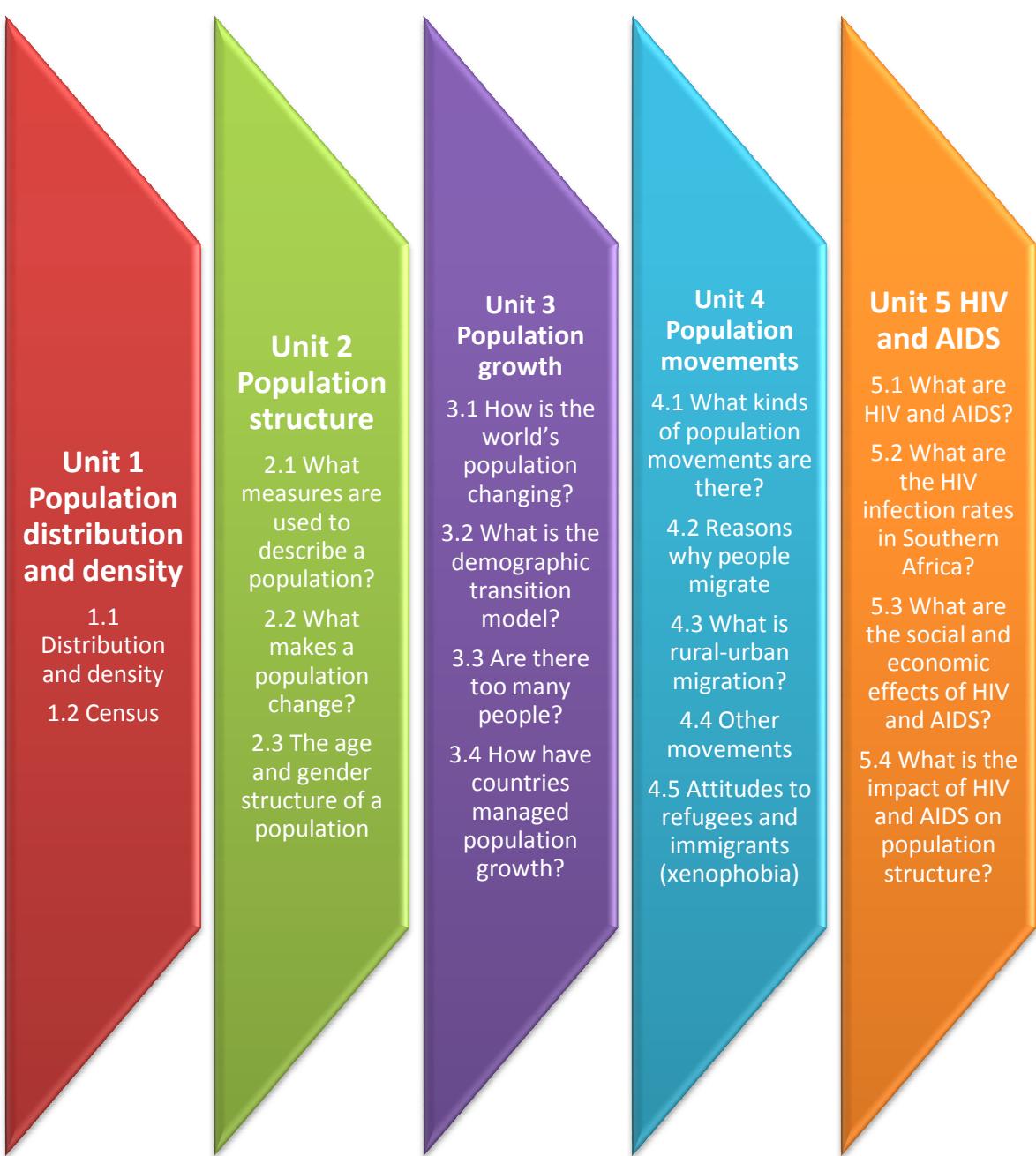
- 1.7 5 cm ($1 \text{ cm a year} \times 5 \text{ years}$) (4)

- 1.8 No, crustal plates must collide to form mountains (4).

- 1.9 Syncline – downward fold. Anticline – upward fold.

Overview

This section comprises five units. These are population distribution and density, population structure, population growth, population movements, and HIV and AIDS. This topic covers content, concepts and issues that are both current and pertinent in South African society. The implications of population growth and HIV and AIDS and their impact on population structure are presented in a concise way. You are given examples of how to interpret population pyramids and understand the demographic transition model. Case studies and tabled summaries provide opportunities for learner discussion, debate and critical thinking.

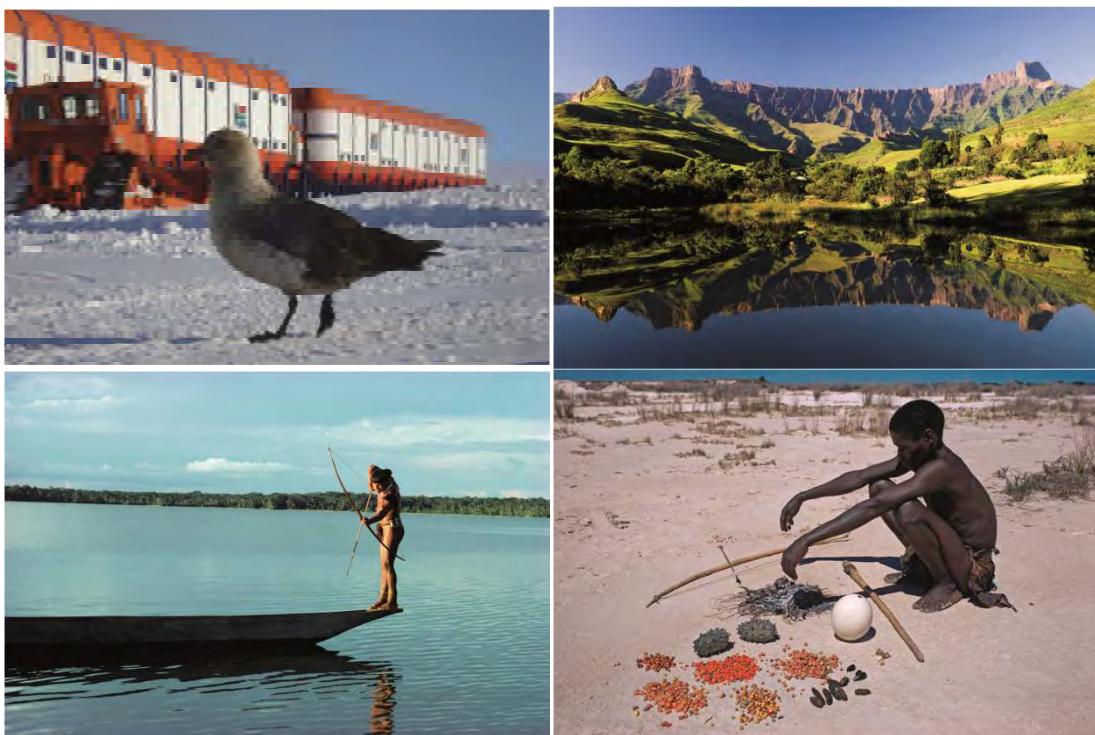


Population distribution and density

Unit 1 Population distribution and density

1.1 Distribution and density

- Population distribution describes how people are spread out on the Earth.
- The population of the world is spread out unevenly.
- Population density is the measurement of how many people there are in an area.
- The following photographs represent sparsely populated regions.
- A reason is given for low population densities in mountainous regions, cold regions, densely forested tropical regions, and desert areas.



1.2 Census

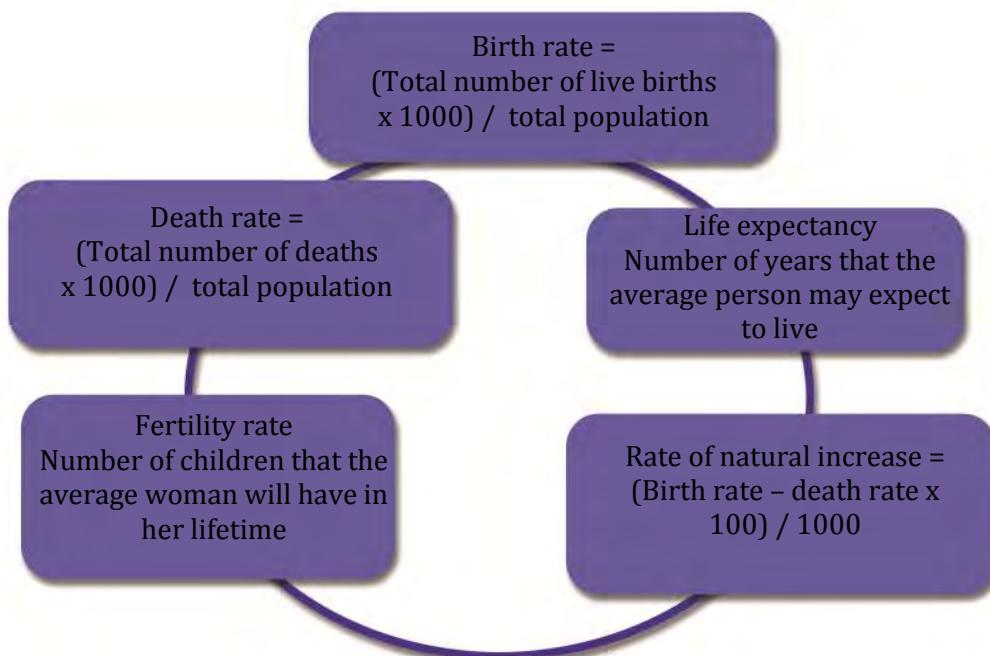
- Information about population is collected during a census.
- A census is a questionnaire issued by governments, usually every ten years.
- Census questionnaires ask for information about age, sex, ethnic group, religious belief and occupation.
- Everyone must be included in the census, by law.
- Governments use census information to make plans for the country's future

Population structure

Unit 2 Population structure

2.1 What measures are used to describe a population?

- World population growth is caused by birth rates being greater than death rates.
- Birth rate – the number of births per 1 000 people per year.
- Death rate – the number of deaths per 1 000 per year.
- Natural increase – population increase because the birth rate is higher than the death rate.
- Natural decrease – population decrease because the death rate is higher than the birth rate.
- Life expectancy and fertility rates are described in the diagram below.

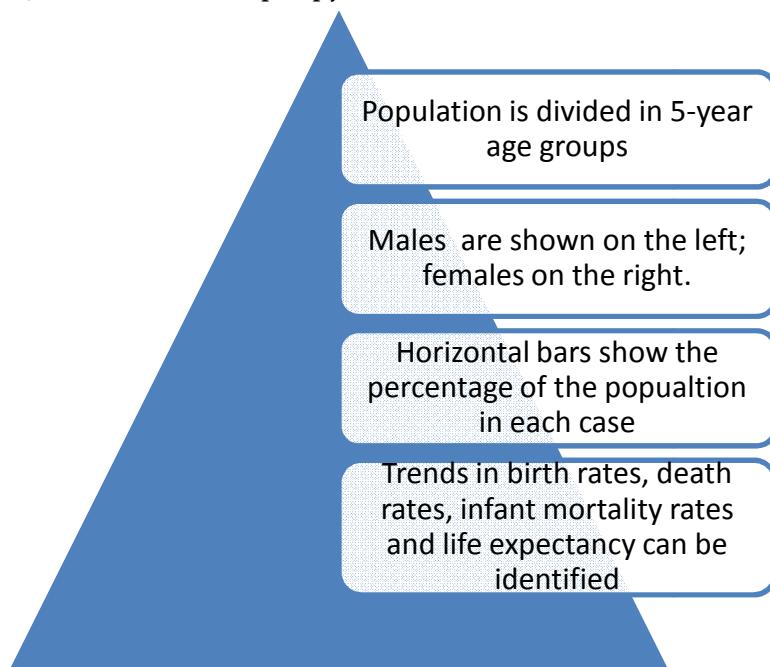


2.2 What makes a population change?

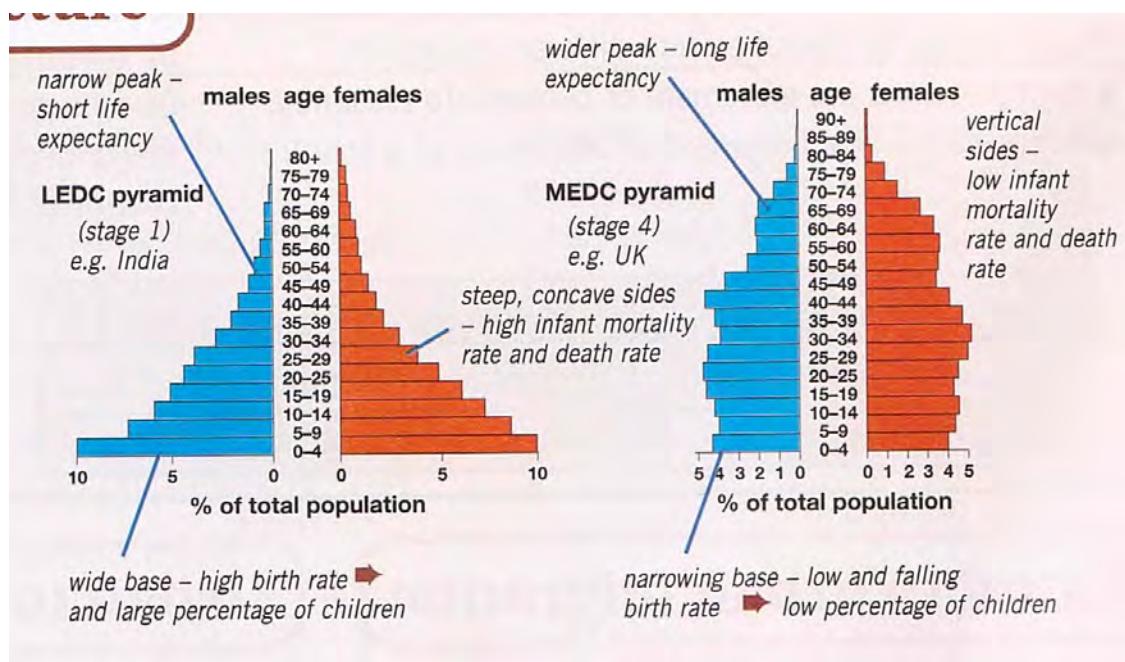
Factors that make populations change				
Factors influencing birth rate	Factors influencing death rate	Factors influencing life expectancy	Factors influencing fertility rate	Factors influencing natural increase
Age and gender structure of a population	Poor medical services	Improvement in health-care and sanitation	Healthcare	War
Level of education	Unhygienic conditions	Level of education	Religion	Disease
Religion	Malnutrition	Poverty	Population policy	
Economic intervention, birth control and contraception	Age structure		Contraception	
Poor nutrition and sexual drive	Socio-economic conditions			
Wars	Inadequate housing			
Migration	Wars			
Natural disasters	Natural disasters			

2.3 The age and gender structure of a population

- Population structure is the make-up of a population in terms of **age, sex** and **life expectancy**.
- Population structures are shown as **population pyramids**.
- Less economically developed countries (LEDCs) and more economically developed countries (MEDCs) have different shaped pyramids.



Population structure

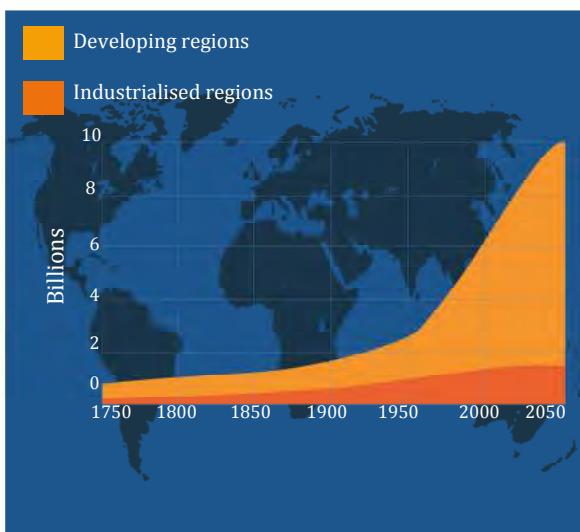


Population growth

Unit 3 Population growth

3.1 How is the world's population changing?

- For most of human history the world's population remained steady. It took until 1800 for it to reach one billion. Today the world's population is over six billion.
- This rapid growth in world population is called the population explosion and is the result of reduced death rates due to improvements in medicine.
- Global population growth is now beginning to slow. It is predicted the population will stabilise at 10,4 billion in 2200.
- Population growth is not spread equally between countries – 95% of growth is in LEDCs.
- MEDCs have reached a replacement level of population growth or are experiencing a decrease.
- The following diagram represents the difference in growth rate between developed (MEDCs) and developing(LEDCs) countries.



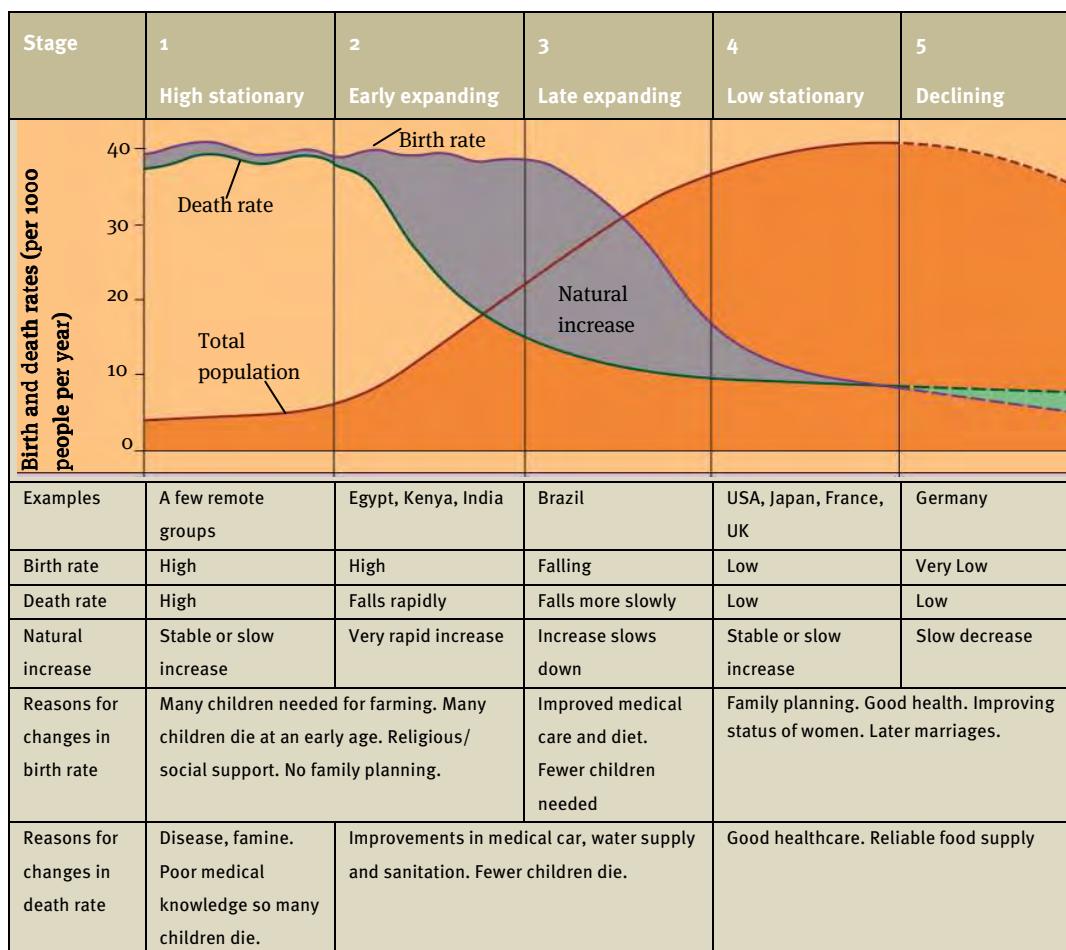
The following table provides an overview of population growth in economically developing countries in contrast with their counterparts.

Less economically developing countries	More economically developed countries
Characterised by fastest population growth – population is increasing 6× faster than the growth rate in developed countries.	Very slow population growth.
86% of the world's population lives in Africa, Asia and South America.	Some countries in north-west Europe have a zero growth rate.
HIV/AIDS affecting population growth – will limit growth in Africa in next 20 years.	Europe's population is decreasing by 1 million people per year. Australia, Japan, New Zealand and North America – natural increase of about 2,1 million people per year.
99% of total natural increase occurs here – contains 81% of the world's population.	On average, natural Increase is 1,4%.
90% of the world's births per year – higher infant deaths.	

Population growth

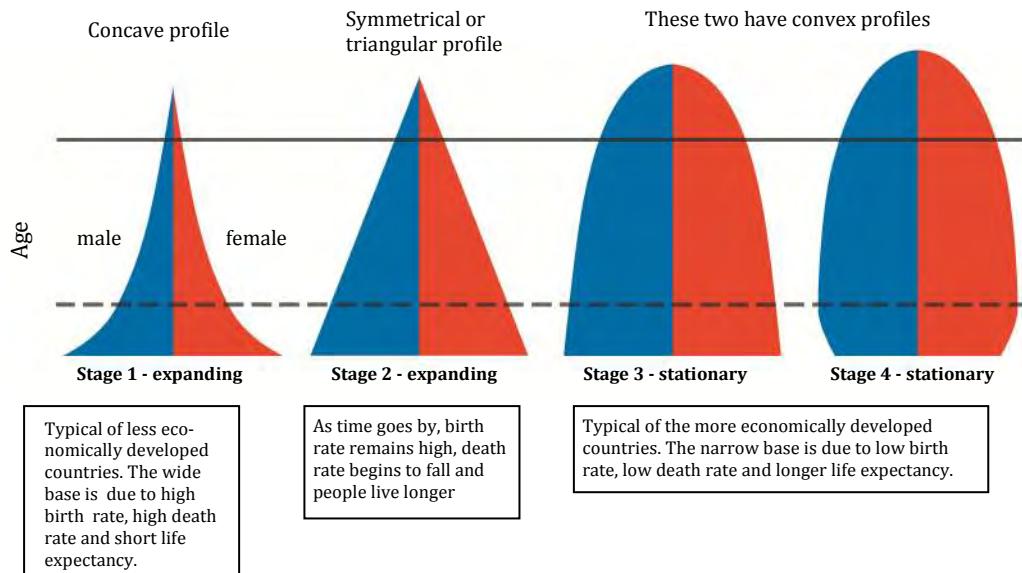
3.2 What is the demographic transition model?

- The demographic transition model shows how changes in birth rates and death rates affect population growth in countries at different stages of development.
- The model may be used to explain population change in five stages (see diagram below).
- MEDCs (more economically developed countries) are entering a fifth stage where death rates exceed birth rates and populations are falling.
- These stages and corresponding population pyramids can be illustrated graphically.



The demographic transition model

Population growth



3.2.1 Stage 1 – High Stationary

- Birth rates high due to lack of contraception.
- Death rates high due to poor diets and disease.
- Population **grows very slowly**.

3.2.2 Stage 2 – Early Expanding

- Birth rates high as children are needed for labour.
- Death rates fall due to improve diets and healthcare.
- Population **grows rapidly**.

3.2.3 Stage 3 – Late Expanding

- Birth rates fall due to growth of urban areas (less labour is needed on farms).
- Death rates low due to good diets and healthcare.
- Population **grows more slowly**.

3.2.4 Stage 4 – Low Stationary

- Birth rates low as women's rights improve, and contraception becomes easily available.
- Death rates low due to high-quality healthcare.
- Population is **stable**.

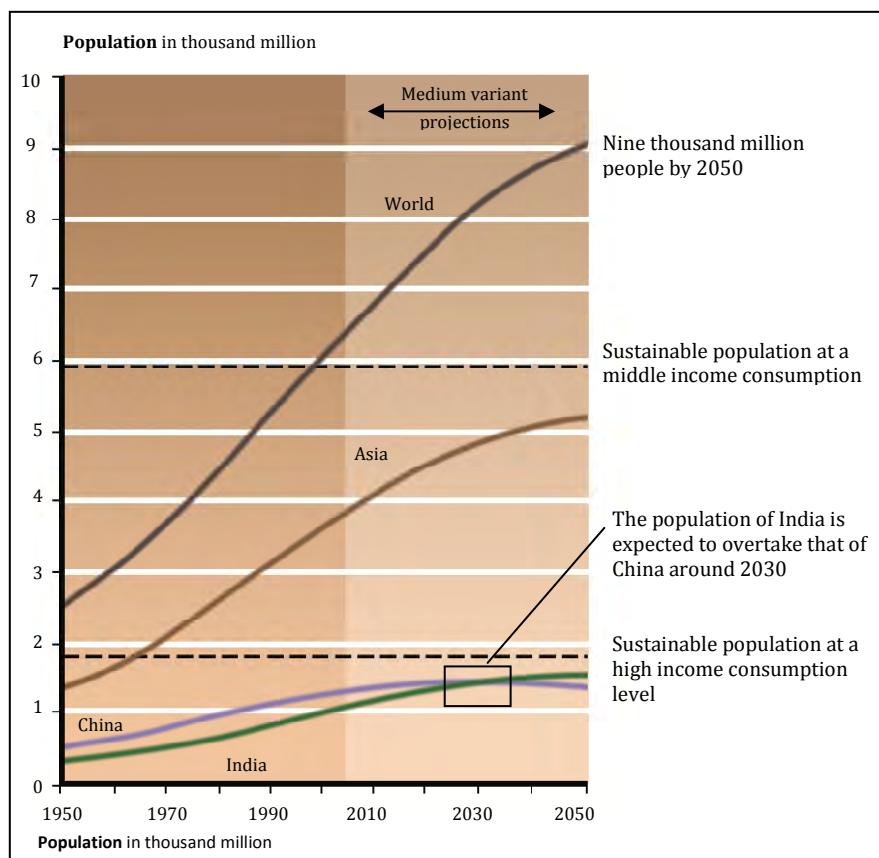
3.2.5 Stage 5 – Declining

- Birth rates fall as women choose higher education and careers over having children.
- Death rates low due to continued medical advances.
- Population **declines slowly**.

Population growth

3.3 Are there too many people?

- A country is said to be overpopulated if its increasing population leads to a lowering of living standards.
- For example, the Netherlands has one of the highest population densities in the world but it is not overpopulated because its standard of living goes on increasing despite any population increase, if any.
- Singapore is a densely populated area, which introduced a successful family planning scheme (social and economic incentives would cease if the size of the family grew, contraceptives at low cost, legislated abortion and sterilisation, a voluntary 'stop at two policy' and advertises smaller families).
- Somalia, with a very low population density, is overpopulated because the increasing population results in a lowering of living standards in a very poor country.
- Population problem – Add 240 000 people each day, 90 million people a year which doubles every 40 years; world population at 6,1 billion; 9 billion by 2050.
- Study the graph below representing the above-mentioned projection.



Population growth

3.4 How have countries managed population growth?

Why introduce population policies? To develop population policies, first it's necessary to understand why people in LEDCs have large families. Reasons include the following:

- Labour – children are needed so that they can work and contribute to the family income.
- Old age – people without pensions rely on their children to support them.
- Infant mortality – poor healthcare means that not all children survive to adulthood.
- Religion – some religions disapprove of contraception.
- Contraception – birth control methods may be unavailable, or illegal.

Governments may encourage people to have fewer children through:

- Advertising – attempting to change attitudes and culture.
- Financial – offering bonuses to those with small families.
- Education – teaching women about family planning.
- Healthcare – reducing the infant mortality rate and provide contraception.
- Law – rules limiting the number of children.

Example: China (population: 1,3 billion)

Population policy	Effects of policy
1979 – one child per family announced. Permission is necessary to marry and have children. Women must be at least 25 to marry. Free health care, monthly allowance and improved pension for one-child families. Fines for parents having two children. Forced abortions and sterilisations have been reported.	Birth rates have fallen and population growth has slowed. Boys are more valued than girls – female babies have been abandoned. Population is becoming unbalanced – 110 males to 100 females Ageing population will cause dependency problem
The one child policy has been relaxed in recent years. Women may be allowed to have a second child if the first is a girl.	

Population movements

Unit 4 Population movements

4.1 What kinds of population movements are there?

Migration can be classified into different categories.

- Immigration is the movement of people into a country.
- Emigration is the movement of people out of a country.
- International migration is controlled by governments. They may encourage or discourage migration into their country. Illegal migrants will be returned to their country of origin (deported).

Internal – same country	International – between countries
Permanent – stay for good	Temporary – return home later
Voluntary – own choice	Forced – no choice

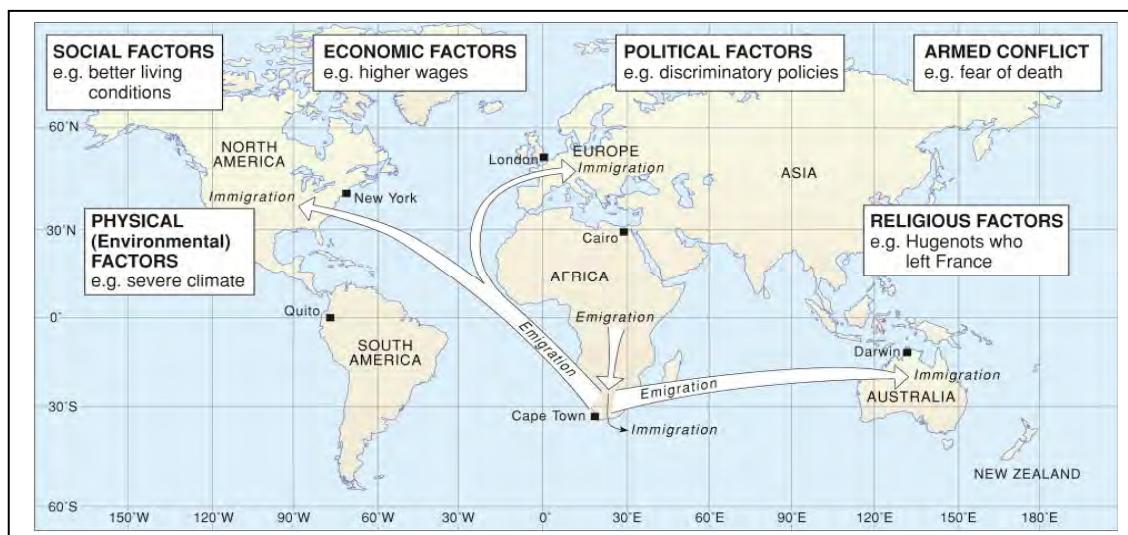
4.2 Reasons why people migrate

Forced migration (push factor)	Voluntary migration (pull factor)
Wars and conflict	Better employment opportunities
Bad treatment (race, religious or political beliefs)	To be with friends and family who moved
Unsafe conditions because of crime	Better climate
Natural disasters (earthquakes, volcanoes, hurricanes, volcanic eruptions)	Better social opportunities
Shortage of food	Better educational opportunities

4.2.1 Factors which may cause people to migrate

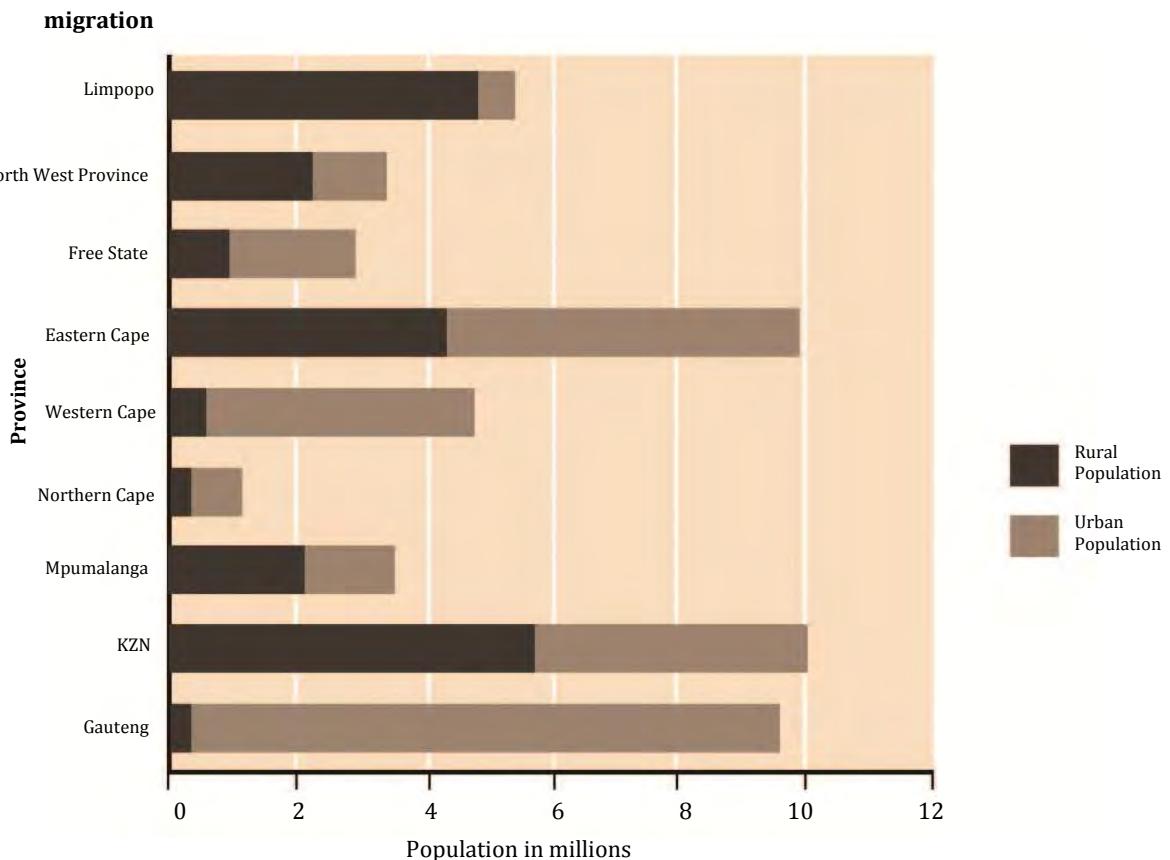
- Social factors – the desire to live a better life, housing, environment, improved living conditions, improved services, facilities, activities, relationships.
- Political factors – people move because they are unhappy with the political system, mainly a push factor.
- Economic factors – seeking a better job from business or industry.
- Religious factors – people may move to avoid being persecuted because of their religion. Move to where they can practise their religious beliefs.
- Physical factors – people may move to avoid physical dangers, a harsh climate or infertile soil.

Population movements



4.3 What is rural-urban migration?

- Rural to urban migration is the movement from rural to urban areas. This process is called urbanisation.
- Today urbanisation is happening mainly in LEDCs.
- 43% of South African people live in rural areas.
- In Gauteng, the economic hub of Africa, more people live in urban areas. This trend is followed in the Western Cape.



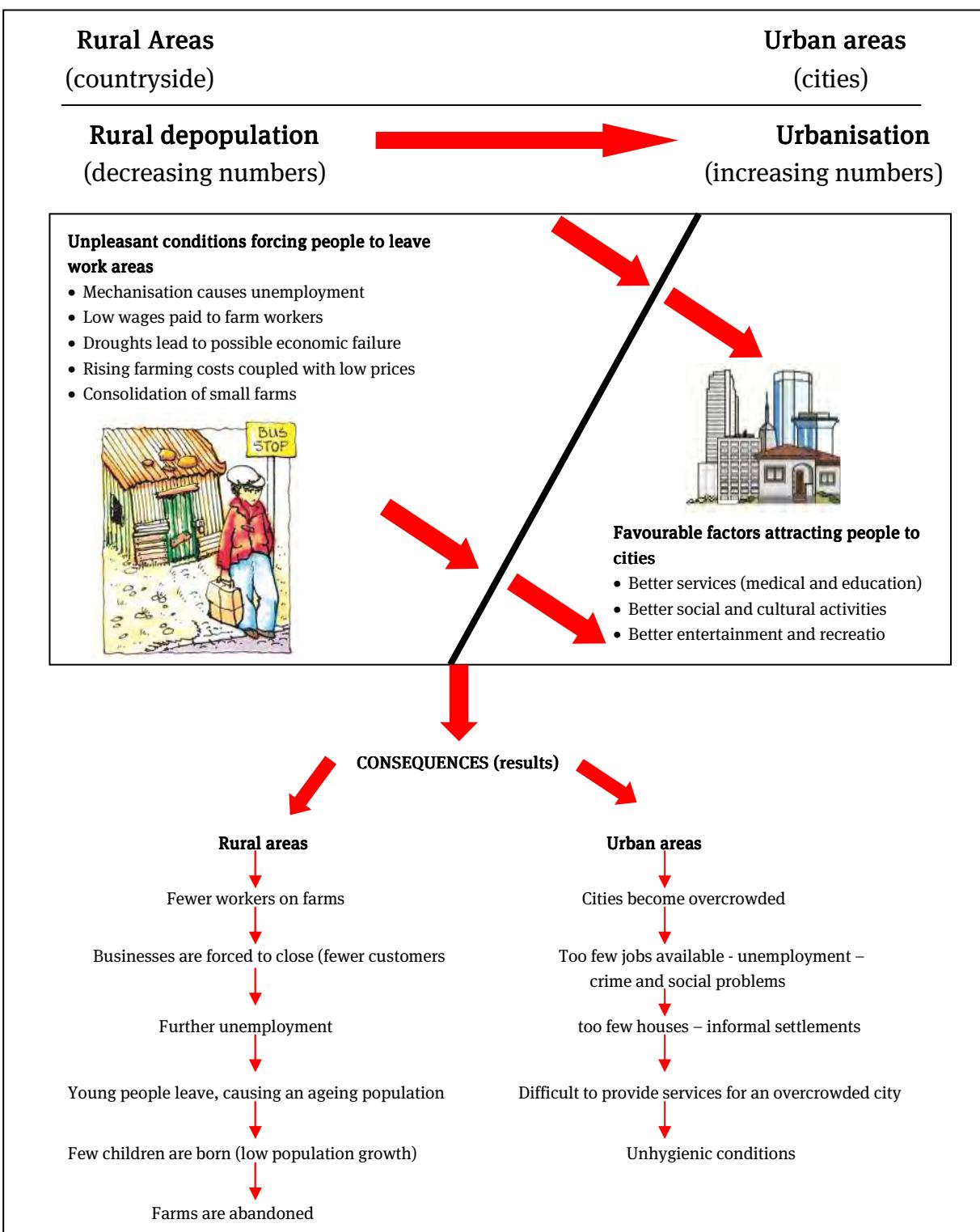
Population movements

4.3.1 Cycle of poverty



- Many people in poorer rural areas are trapped in a cycle of poverty.
- Young economically active people leave the rural areas, leaving dependants (aged and young) behind.
- Dependents wait for money – lose hope and courage to try new ideas.
- Farms are neglected or abandoned. No one to do hard work. Productivity drops and unemployment rises.
- Decreased productivity in the private sector affects the secondary and tertiary sectors – economy declines.
- Rural shops, schools and certain services close down – lack of customers to make a profit.
- The following diagram summarises the process of urbanisation.

Population movements



Factors responsible for rural depopulation

Population movements

4.4 Other movements

4.4.1 Seasonal movements

- Transhumance is the seasonal movement of people with their livestock over relatively short distances, usually to higher pastures in summer and to lower valleys in winter.
- The traditional economy of the Basotho in Lesotho – seasonal migration between the valleys and high plateaus of the Maluti mountains to increase the number of cattle.

4.4.2 Daily movements

- From home to work.

4.4.3 Temporary movements

- People stay in a place temporarily – for a short time only. Migrant labourers move to another area temporarily to seek employment.
- Many migrant labourers are men who return home with their savings or later have their family join them.
- Refugees who leave for political reasons may migrate temporarily to another area either temporarily or permanently when lives are in danger. The Rwandan civil war in early 1990s created more than 1,5 million refugees.
- Some people's beliefs (religion, political) may differ with the current status quo.
- Tourism, short contract work, business travel, conferences and conventions are also examples of temporary movements.

4.4.4 Permanent movements

- People who move to a place and decide to stay permanently – no plans to leave.
- Depending on government policy, migrant labourers sometimes settle permanently in their area of work or employment.
- Approximately 75% of countries have agreed to protect refugees and not return them to their home country.
- Accepted refugees have a clear legal status – protected by the United Nation's High Commission for Refugees (UNHCR).
- At times, people move because of policies and projects (large scale infrastructural projects like building dams, roads, airports) aimed at developing underdeveloped areas.
- Urban area clearance, mining, deforestation, creation of conservation parks, nature reserves, biosphere projects can cause people to move.

Population movements

4.5 Attitudes to refugees and immigrants (xenophobia)

Negative attitudes towards immigrants are attributed to various factors:

- Refugees are people who have been forced to leave their home country because of war, persecution or natural disaster. The United Nations estimates there are over 13 million refugees spread throughout 140 countries.
- Perceptions people have of immigrants taking away jobs that only citizens are entitled to, especially where jobs are in short supply.
- Foreign traditions and practices that are different from those of local people.
- Fear or hatred for foreigners – local people attack immigrants.
- Pressure on existing services (water, electricity, housing, food).

HIV and AIDS

Unit 5 HIV and AIDS

5.1 What are HIV and AIDS?

The AIDS epidemic is one of the most destructive health crises in modern times. It destroys families and whole communities across the world. It is a pandemic because it is widely spread across the world.

- What is HIV? Human Immunodeficiency Virus – the virus that causes AIDS.
- Transmitted by body fluids from one person to another, weakening the body's immune system.
- What is AIDS? Acquired Immune Deficiency Syndrome – when the body is unprotected from harmful infections.

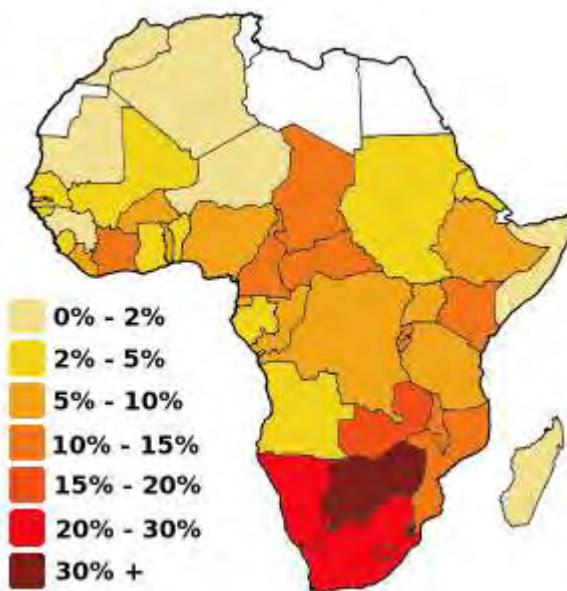
5.2 What are the HIV infection rates in Southern Africa?

11% and above of the adult population in Malawi, Zambia, Zimbabwe, Mozambique, Namibia, Botswana, Lesotho, Swaziland and South Africa has HIV. It can lead to AIDS, the number one killer in the area.

HIV prevalence (%) by province 2002 - 2008			
Province	2002	2005	2008
KwaZulu-Natal	11.7	16.5	15.8
Mpumalanga	14.1	15.2	15.4
Free State	14.9	12.6	12.6
North West	10.3	10.9	11.3
Gauteng	14.7	10.8	10.3
Eastern Cape	6.6	8.9	9.0
Limpopo	9.8	8.0	8.8
Northern Cape	8.4	5.4	5.9
Western Cape	10.7	1.9	3.8
National	11.4	10.8	10.9

(source: statistics South Africa)

Study the map of Africa below, showing HIV infection rates. The key on the map indicates the percentage of the total adult population infected with HIV. That's more than one adult in five in each of Zimbabwe, Botswana, Swaziland, South Africa, Namibia and Zambia, on 28 May 2011. Compare this map with the one in the Learner's Book (page 196) and note the increase in the incidence of infection since 2000.



HIV and AIDS

5.3 What are the social and economic effects of HIV and AIDS?

- Destabilisation of families — loss of income, drop in savings. Healthcare and funeral costs rise.
- Health facilities struggle to cope — pressure on healthcare facilities, costs of treating AIDS and AIDS-related opportunistic infections rise.
- Production of goods — decreased food production, decline in labour supply, skills losses, absenteeism linked to high productivity costs, healthcare costs rise.
- Economy of country — drop evident in reduced GDP.

Projections of how HIV and AIDS will affect the labour force		
Southern Africa: percentage labour force loss due to HIV/AIDS (%)		
	By 2005	By 2020
Botswana	-17.2	-30.8
Lesotho	-4.8	-10.6
Malawi	-10.7	-16.0
Mosambique	-9.0	-24.9
Namibia	-12.8	-35.1
South Africa	-10.8	-24.9
Tanzania	-9.1	-14.6
Zimbabwe	-19.7	-29.4

(source: BERESFORD, B. AIDS TAKES AN ECONOMIC AND SOCIAL TOLL, AFRICA RECOVERY, VOL.15 NO 1-2 (JUNE 2001)

5.4 What is the impact of HIV and AIDS on population structure?

- Affects mainly the age group 20 to 49, which is the most productive economically.
- Affects more women than men. Creates child-headed families.
- In 2008, two million people died from AIDS; 33.4 million living AIDS; 2.7 million newly affected with AIDS.
- In developing countries very old and very young die.
- In South Africa 60% of deaths were in the age group 20-49 yrs.
- Death rates rise quickly and life expectancy drops.

Population distribution and density

Questions

Question 1

Refer to the source below on HIV and AIDS in South Africa and answer the questions that follow, for 20 marks.



The campaign loveLife has run since 1999 and uses a wide range of media directed mainly towards teens.

AIDS is one of the main contributors to South Africa's infant mortality rate. Between 1990 and 2001 the infant mortality rate increased significantly from 44 deaths per 1000 infants to 56,9 per 1000 infants. Although infant mortality remains high in South Africa, it has declined steadily since 2003 to a rate of 46,9 per 1000 infants in 2010.

There are several large-scale communication campaigns related to raising awareness of HIV and AIDS, as well as broader health-related issues. A principal part of the HIV counselling and testing (HCT) campaign launched in April 2010, is to scale up awareness of HIV.

Khomanani, meaning 'caring together', ran since 2001 and was the government Health Department's premier AIDS-awareness campaign.

Soul City and Soul Buddyz are two multi-media campaigns – targeted at adults and children, respectively – that have a combined annual budget of R100 million, and utilise broadcast, print and outdoor media to promote good sexual health and well being.
 [Source: www.southafrica-pig.blogspot.com]

- 1.1 When (date and month) is World Aids Day? (2)

Population distribution and density

- 1.2 What is the purpose of World Aids Day? (4)
- 1.3 Why is there a need to establish a day towards AIDS campaigning? (4)
- 1.4 What was the infant mortality rate in 1990 and 2001, respectively? (4)
- 1.5 Mention three AIDS-awareness campaigns. (6)

Population distribution and density

Answers to Questions

- 1.1 1 December (2)
- 1.2 To raise awareness, in order to reduce the HIV infection rate (4).
- 1.3 There is an increasing rate of HIV and AIDS in South Africa (4).
- 1.4 44 deaths per 1 000; 56,9 deaths per 1 000 (4)
- 1.5 Khomanani; Soul City and Soul Buddyz; loveLife campaign (6)

Overview

This section comprises four units. These are water in the world, the world's oceans, water management in South Africa, and floods. This section is particularly important in South Africa, with water shortages and flooding affecting many communities and costing billions of rands to address. This section concisely presents relevant content, concepts and issues with the aid of appropriate sources taken from the Grade 10 Learner's Book. It provides the learner with opportunities for further inquiry and easily can be supplemented or enriched with relevant and current media reports. This section is informative and interesting even to a non-geographer.

Unit 1 Water in the world	Unit 2 The world's oceans	Unit 3 Water management in South Africa	Unit 4 Floods
<ul style="list-style-type: none">•1.1 The different forms of water•1.2 The hydrological cycle	<ul style="list-style-type: none">•2.1 Source of oxygen, food (fish farming), energy and wealth•2.2 Ocean currents•2.3 Forces causing ocean currents•2.4 Major ocean currents•2.5 Economic activities•2.6 Desalination processes•2.7 Ocean pollution	<ul style="list-style-type: none">•3.1 Water in South Africa•3.2 Predicted climate change affecting South Africa•3.3 Rivers, lakes and dams in South Africa•3.4 Factors affecting the availability and quality of water in South Africa	<ul style="list-style-type: none">•4.1 Physical causes of floods•4.2 Human causes of flooding•4.3 Flood hydrographs•4.4 Flood characteristics and flood management

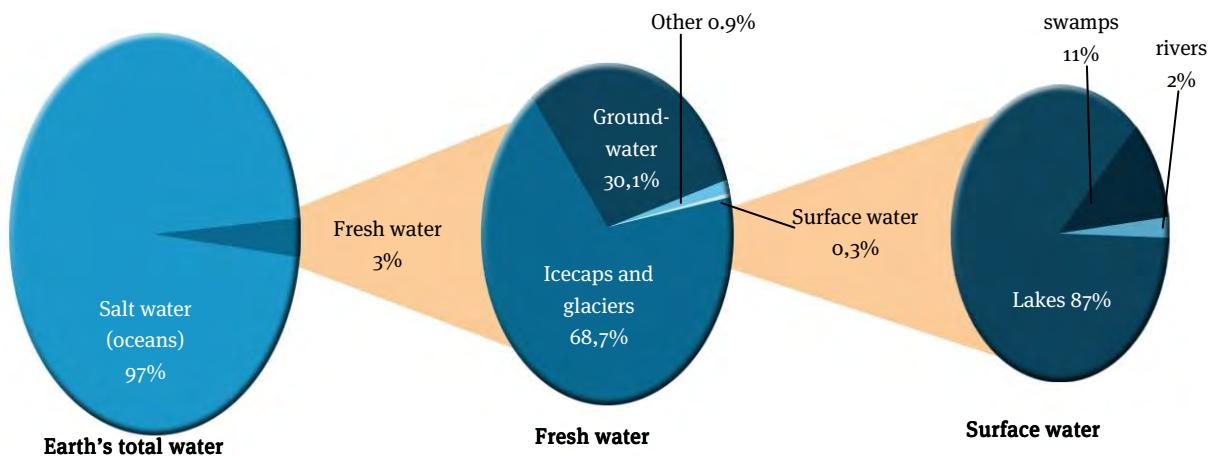
Water in the world

Unit 1 Water in the world

1.1 The different forms of water

Water occurs in three states: solid (ice), liquid or gas (vapour).

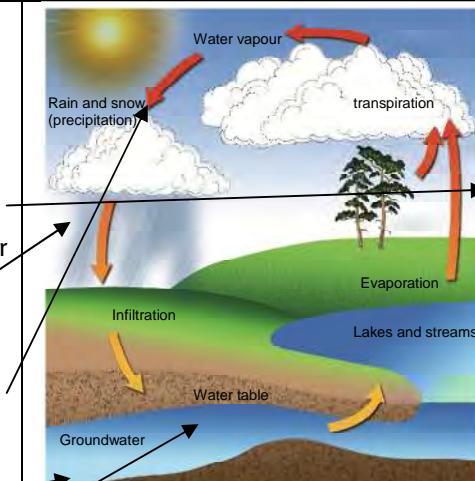
- Ice is frozen water. Ice is less dense (lighter) than the same volume of water. Water molecules move further apart when it freezes.
- Liquid water is wet and fluid.
- Water vapour is found in the air, where it attaches to dust particles. Water vapour molecules combine to form water droplets. With increasing temperatures (warmer) rain forms from water vapour molecules. With decreasing temperatures, snow or hail form.
- When water vapour cools, it condenses into tiny water droplets, which forms a cloud.



1.2 The hydrological cycle

The water (hydrological) cycle is powered by energy from the Sun. It is the exchange of moisture between the oceans, atmosphere and land.

- Evapotranspiration — water loss from lakes, oceans and plants — results in water vapour in the air.
- Water vapour condenses to form water droplets, which form clouds.
- Moisture that cools (or gets very cold) creates precipitation (rain sleet, hail or snow) returning water to the sea and land (ground water and runoff).
- Ground water soaks into the ground.



Water in the world

<p>Most (97%) of the water on the planet is found in the oceans and is salty.</p> <p>Of the remaining 3% fresh water:</p> <ul style="list-style-type: none">• 30,1% is ground water• 68,7% is in the form of ice caps/glaciers• 0,9% other and 0,3% is surface water. <p>0,036% of the Earth's total water supply is found in lakes and rivers.</p>	<p>KEY CONCEPTS</p> <p>Evapotranspiration, condensation, freezing and precipitation (rain/ hail).</p> <p>Temperature conditions determine whether water vapour (warm), rain (cooling of rising warm air) or hail/snow (cold) form.</p> <p>Liquid to gas — evaporation; gas to liquid — condensation; liquid to solid — freezing.</p>
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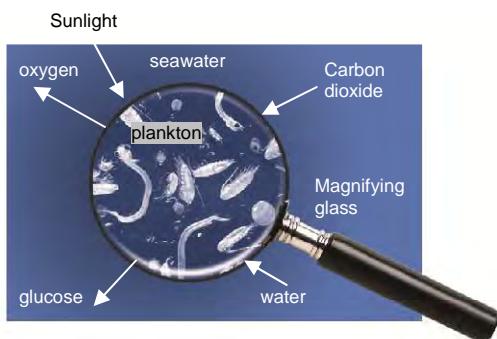
The world's oceans

Unit 2 The world's oceans

2.1 Source of oxygen, food (fish farming), energy and wealth

2.1.1 A source of oxygen

- Of the 98% of our oxygen that comes from photosynthesis on land and sea, nearly half comes from our oceans.
- Photosynthesis converts carbon dioxide into organic compounds using the energy from sunlight. Oxygen is released in the process.
- Algae and plankton in the oceans carry out photosynthesis.
- Plankton are one-celled plants that live in the oceans. All sea life depends upon plankton for survival.



2.1.2 A source of food

- Millions of tons of fish are harvested from the sea every year.
- Fish provide a healthy and reliable source of food.
- The result is over fishing and reduced stock levels of certain types of fish.
- Fish farming involves raising fish commercially in tanks or enclosures, to increase stock levels, mainly for food.
- Fish farming provides marketers with another source of fish.
- Farming fish such as tuna and salmon increases pressure on wild fisheries because they are fed on fishmeal and fish oil extracted from wild fish.
- Thus these fish consume in weight much more than they weigh themselves.
- In 2008, 33.8 million tonnes of fish was farmed globally earning \$60 billion.

2.1.3 A source of energy

- The ocean – its waters, the air above it and the land beneath – is rich in energy resources.
- Non-renewable energy sources – oil and gas.
- Renewable energy sources – wind energy, wave energy, ocean current energy and solar energy.
- Much of the world's oil and gas comes from beneath the ocean floor.

The world's oceans

2.1.4 A source of wealth

Tourism

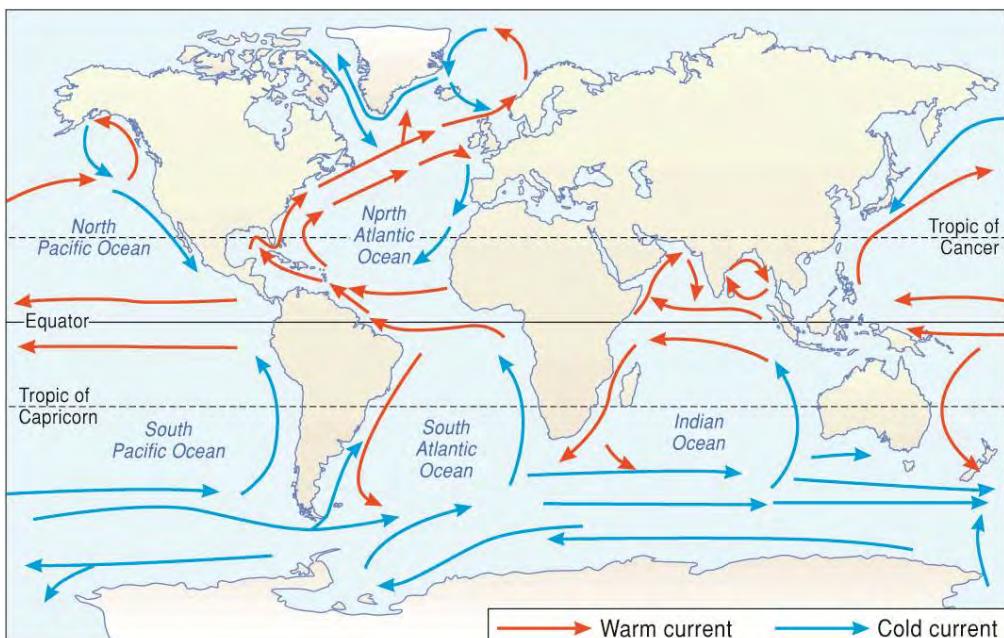
- The warmer oceans and islands attract tourists, cruise liners and investment and employment.
- A country's economy is strengthened by these activities. Ecotourism is also a significant venture in such countries.
- Example: Kwa-Zulu Natal's coastal tourism industry

Trade

- Fishing industries in colder nutrient rich oceans facilitate trade.
- Examples: West coast, Cape Town, Namibia

2.2 Ocean currents

What are ocean currents? An ocean current is the horizontal movement of water on a large scale in the oceans. It is a steady flow of ocean water in a constant direction.



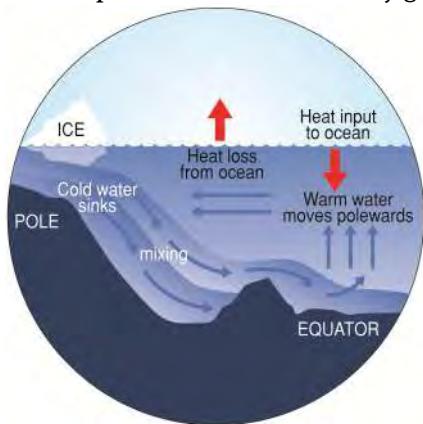
2.2.1 How ocean currents influence climate

- The air above the warm ocean current is warmed by the water.
- The air above the cold ocean current is cooled by the water.
- Warmer air can hold more water vapour than cooler air.
- Ocean currents have a great influence on climate because of their effect on temperature and humidity.

The world's oceans

2.3 Forces causing ocean currents

- Wind — The friction of wind on the surface moves water. When wind blows constantly, the current flows quickly.
- Salinity — More salty water is denser than less salty water. When the two masses meet the denser saltier water will sink.
- Temperature — The colder water gets, the denser it gets. Colder water will sink.
- The Earth's rotation — The Coriolis force is caused by the Earth's rotation. Movement of air or water in the Northern Hemisphere is deflected or moved slightly clockwise to the right, and slightly anti-clockwise in the Southern Hemisphere.
- Gravity — One of the major forces affecting currents. The movement of water due to salinity and temperature is influenced by gravity. Gravity makes the dense water sink.



2.4 Major ocean currents

2.4.1 In the world

- One of the best-known currents is the warm Gulf Stream.
- It flows north-east from the USA to north-western Europe.
- It is a 100 km wide and 800-1 200 metres deep.
- Its average speed is about 9 km/h.
- It is also known as the North Atlantic Drift.

2.4.2 In South Africa

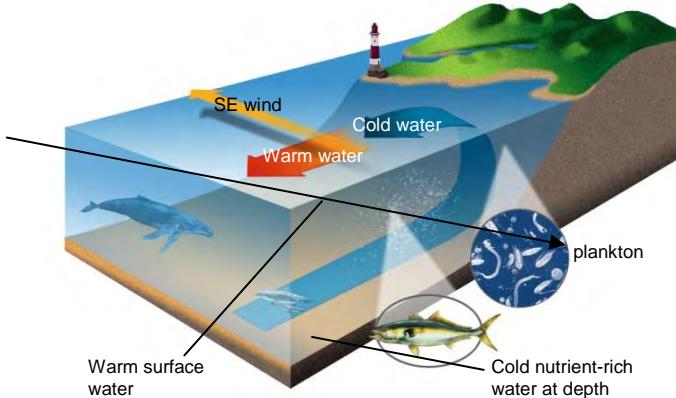
- South Africa has a warm ocean current — Agulhas — on the east coast and a cold ocean current — Benguela — on the west coast.
- The Agulhas current is the world's fastest, flowing at 10 km/h.
- Desert conditions characterise the west coast because of the cold current.

The world's oceans

2.5 Economic activities

2.5.1 Fishing

- A quarter (25%) of the world's fish harvest comes from oceans with cold currents (5% of total ocean area).
- South Africa's fishing industry is worth about R2 billion annually.
- It employs about 30 000 people.
- A large percentage of our fish comes from the upwelling nutrient-rich waters of the cold Benguela current.
- The cold nutrient-rich waters of the Benguela current rise up when the south-easterly winds blow the surface water to the north-west.
- When the wind blows away the surface water, water from below the surface takes its place.
- This upward movement of water is called upwelling.
- This upwelling takes place along the west coast of Africa from Cape Town to as far as northern Namibia.
- Colder water from below is more nutrient-rich than the warmer surface water.
- Plankton and fish move upward with the colder, nutrient rich water, providing fishing opportunities. Downwelling – downward moving surface water – reduces the amounts of nutrients and fish in an area.
- When the wind stops, upwelling stops, and plankton and fish are not attracted to the area.



2.5.2 The causes and effects of over fishing

Over fishing occurs when more fish are caught and removed from an area than are born in that area. Thus fishing becomes unsustainable. Effects of over fishing include:

- quotas to limit the amount of fish that people catch
- very low levels of fish in certain areas
- the removal of all fish in some areas
- loss of jobs
- loss of money
- excessive time usage and un-productivity involved in fishing activities where fish stocks have declined.

The world's oceans

2.5.3 Management strategies to prevent over fishing

- Issuing fishing permits and quotas.
- Strategies that educate people about limited or threatened fish stocks such as South African Sustainable Seafood Initiative (SASSI).
- SASSI produced a pocket-sized card that informs people about fish that have low stock levels (orange – think twice, red – don't buy) and good stock levels (green – best choice).

2.5.4 Tourism

- Warm ocean currents lead to a year-round tourist industry.
- The Indian Ocean's Agulhas current off South Africa's east coast is an example.
- KwaZulu-Natal's tourism industry is worth about R20 billion per year.
- In 2010, over 500 000 visitors from overseas came to KwaZulu-Natal to enjoy its golden beaches and warm water.

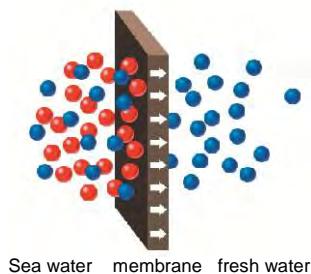
2.5.5 Trade

- In the past, winds and ocean currents influenced shipping and trade routes.
- Today ship's captains use ocean currents to speed up their journeys.

2.6 Desalination processes

The desalination process is obtaining fresh water from seawater by removing salt.

- Many ships and submarines use desalination to obtain fresh water.
- Desalinating large quantities of water requires lots of energy and a lot of expensive equipment.
- A boiling process can separates the fresh water from salt.
- A process called reverse osmosis uses a specialised membrane which lets water through but not salt.



2.6.1 Desalination in South Africa

- An option but very costly – consumes a lot of electricity and produces very large quantities of salt.
- A few small plants use the reverse osmosis process – on the Eastern Cape coast and at Sedgefield near Knysna.

The world's oceans

2.7 Ocean pollution

The pollution of the ocean is caused by:

- Oil spills from tankers and oil wells
- Rubbish dumped into the sea – toxic waste and mining materials
- Polluted ground water (farming chemicals and pesticides) and the disposal of the contents of septic tanks, pesticides, animal dung, household waste, waste water and nuclear waste
- Fishing nets from boats or plastics that are thrown into the sea.

2.7.1 Effects of pollutants on the sea

- Death of marine wildlife.
- High cost of clean-up operations.
- Reduced stock levels and contaminated water.

2.7.2 Ocean pollution management strategies

- Use non-toxic chemicals in homes, on farms (pesticides and fertilisers) and in industry.
- Responsible dumping and waste disposal strategies that reduce contamination.
- Recycle oil.
- Reduce litter and plastic usage.

Water management in South Africa

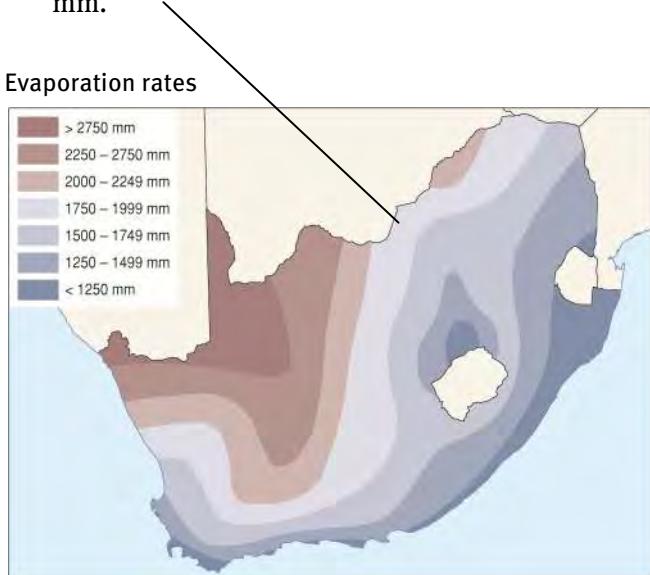
Unit 3 Water management in South Africa

3.1 Water in South Africa

- South Africa is a semi-arid country – one of the 30 driest countries in the world.
- Uneven water availability across the country – annual rainfall varies from less than 100 mm (west coast) to 1000 mm (east coast).
- Large parts of South Africa receive only 250-500 mm of rain per year.
- The average rainfall of about 450 mm a year is well below the world average of 860 mm a year.
- No rain in winter for most of the country. In south-western part of Western Cape no summer rain.
- Large amount of water is lost through evaporation annually.

3.2 Predicted climate change affecting South Africa

- A general decrease of 5-10% rainfall.
- Longer dry spells in the interior and north-eastern areas of the country.
- Floods probably will be more frequent and more severe.
- Some parts of South Africa could experience greater runoff and stream flow of up to 10%.
- Decrease in runoff on east coast.
- By 2015 water demand will outstrip supply.
- The Vaal area receives an average annual rainfall of 700 mm and loss by evaporation of 1 500 mm.



Water management in South Africa

3.3 Rivers, lakes and dams in South Africa

3.3.1 Rivers and lakes

- South African rivers are small by African and world standards.
- The total flow of all South African rivers is less than half that of the Zambezi River, the closest large river to South Africa.
- Large inter-basin transfers of water have been carried out in South Africa. This process transfers water from one river basin (Orange) to another (Fish) through tunnels and canals.
- There are a few small estuaries (St Lucia) — the wide part of the river where it meets the sea — in South Africa; no large lakes.



3.3.2 Dams in South Africa

Many large storage dams have been built to help store and manage our water supplies. There are more than 500 dams, with a total capacity of 37 000 million cubic metres. These often are part of major water transfer schemes, like the one illustrated below.



Water management in South Africa

3.3.3 The use and impact of dams



The uses of dams	The impact of dams
<ul style="list-style-type: none"> Provide water to towns/cities (Gauteng-Vaal Dam)/recreation Crop irrigation Hydroelectric power – electricity Control/reduce floods 	<ul style="list-style-type: none"> Settlements Ecosystems/biodiversity Climate change Water/environment quality Flooding

3.4 The factors affecting the availability and quality of water in South Africa

The land use practices	The effect of human activities
<ul style="list-style-type: none"> Built surfaces – roads and pavements – in towns and cities reduce infiltration and increase runoff. Polluted city water requires expensive treatment before reuse. Dams, bridges, water transfer schemes (Tugela-Vaal) and canals alter the rate of flow and quantity of water in our rivers. Soil erosion results in silted dams, which reduces dam capacity. Alien vegetation, which uses more water than indigenous vegetation, reduces stream flow by up to 10%. 	<ul style="list-style-type: none"> Industry and mining activities create polluted water supplies – Acid Mine Drainage (AMD) – acidic water from mines. Industrial pollution generates poisonous and hazardous chemicals, increases salinity, nutrients and sediments. Agricultural water pollution (fertilisers and agro-chemicals) – eutrophication

Water management in South Africa

3.4.1 Challenges of providing free basic water (FBW)

- The South African Constitution guarantees human rights to water.
- FBW policy (2000) allows every household 6 000 litres of free water per month.
- Implementing FBW is time-consuming and expensive.
- Rural communities are small and spread out – difficult to reach.
- Urban areas are growing rapidly and increased informal settlements strain service delivery.
- Rapid urbanisation has led to sanitation problems, with sewage contaminating water supplies.
- Agricultural chemicals pollute rivers.

3.4.2 Role of municipalities in water purification and provision

There are three levels of water supply and sanitation.

- National Government (Department of Water Affairs) provides policies that manage water resources, sanitation, plans for new dams, and inter-basin transfer schemes (schemes which transfer water from high supply drainage basins to high demand and supply water areas).
- Water Boards operate dams, offer retail services and run some waste-water treatment plants. Fifteen water boards supply water to nearly half of South Africa's population in 90 municipalities. (Examples: Rand Water, Umgeni Water).
- Municipalities buy water from Water Boards, purify it and sell it to customers, sending out accounts. Some municipalities own their own dams. (Example: Rand Water – One of the largest water utilities in the world. Its distribution network includes 3 056 km of large-diameter pipeline, feeding 58 service reservoirs. It supplies, on average, 3 653 million litres of water daily. Customers are mines, industry, local and metropolitan municipalities.)

3.4.3 Sustainable use of water – what governments and individuals can do

Sustainable water use is using water resources in a way and at a rate that prevents the long-term loss of water.

- Recycle water – purification or sewage treatment plants provide safe, quality water.
- Do not waste water – reduce use of water.
- Do not pollute – affects water supplies.
- Restore wetlands – they reduce erosion, encourage wildlife, store and purify water.
- Remove alien vegetation – high water consumption.

Water management in South Africa

3.4.4 Role of government in building dams and inter-basin transfers

THE ORANGE RIVER PROJECT	THE LESOTHO HIGHLANDS WATER PROJECT
<ul style="list-style-type: none"> • Water from the Orange River at the Gariep Dam goes through tunnels and canals to the Sundays River and then to the Fish River in the Eastern Cape. • Provides water for irrigation and urban use in Port Elizabeth. • The Gariep and Vanderkloof Dams generate hydro-electric power. • Prevents flooding in the lower Orange River. 	<ul style="list-style-type: none"> • Africa's largest water transfer scheme. • Supplies water from Lesotho to Gauteng from a system of large dams and tunnels across Lesotho and central South Africa. • The water runs north from the Katse Dam on the Orange River into the Vaal River basin. • The scheme provides hydro-electrical power in Lesotho – source of income. • Number of planned phases still to complete.
THE BERG RIVER SCHEME	THE TUGELA-VAAL SCHEME
<ul style="list-style-type: none"> • Water is transferred from the Theewaterskloof Dam on the Sonderend River to the Berg River (which has a new dam). • Will capture high winter rainfall and store it for the dry summer months for Cape Town's urban and industrial use. 	<ul style="list-style-type: none"> • A pumped storage scheme that supplies water from the Tugela to the Vaal Dam. Water is pumped through the Drakensberg mountain range. • Supplies 11 million people, irrigation, households, and industries in Pretoria, Witwatersrand and Vereeniging.

Floods

Unit 4 Floods

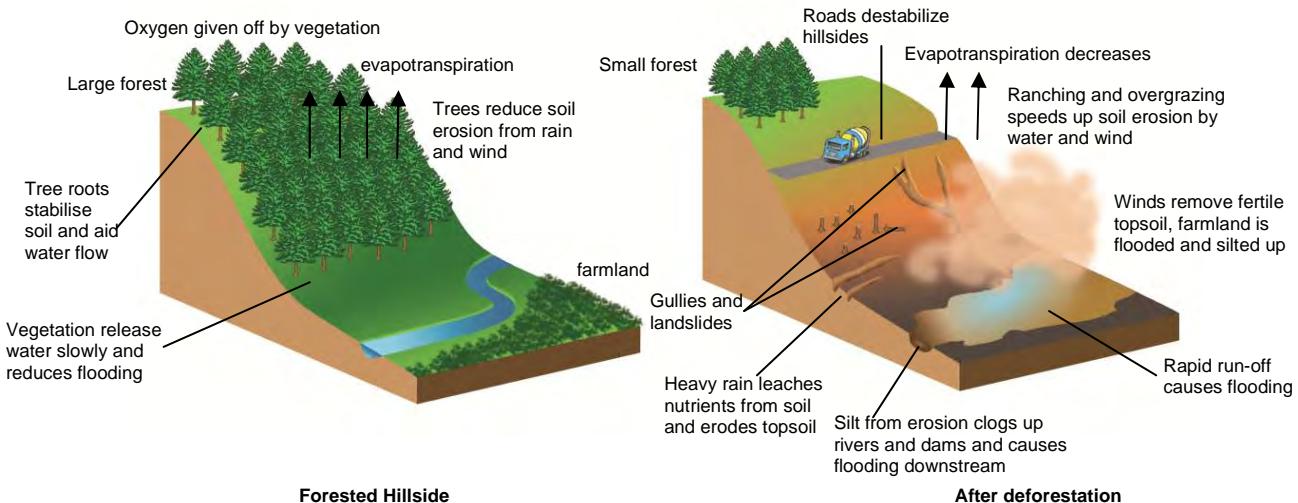
4.1 Physical causes of floods

A flood occurs when a river has more water in it than the river's channel can hold. The water then flows over the banks of the river, onto the adjacent land areas.

- High rainfall over a period of days can yield more rainfall than rivers can carry. Excessively heavy rainfall can result in flash floods that uproot trees, move boulders and destroy buildings.
- Snow melting – Rapid melting of snow, in countries that have heavy snowfalls, can cause floods.
- Relief – Flooding occurs in lowlands where rivers flow more slowly.
- Coastal flooding – Occurs at low-lying coastal areas when there are strong onshore winds with high tide. Storm surges of a tropical cyclone or hurricane, or a tsunami also can cause coastal flooding.

4.2 Human causes of flooding

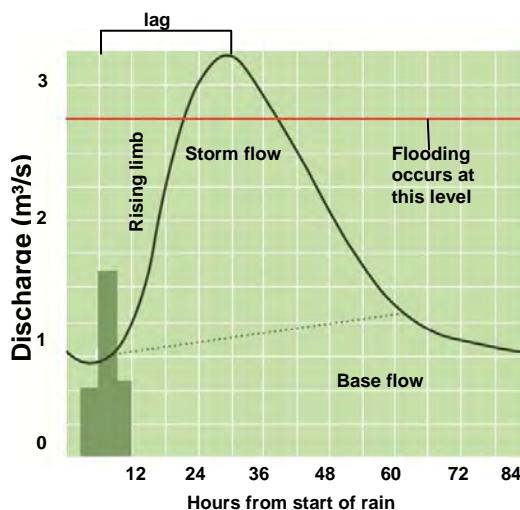
- Deforestation and poor farming practices lead to increased soil erosion, reduced infiltration of water and increased surface runoff.
- Poor water management – Poorly constructed dams that collapse easily lead to flooding. When dam water is released too quickly, downstream areas are flooded.
- Debris – Floating debris like vegetation and ice in water can build up at an obstruction, such as a bridge, and block the flow of water, leading to a river overflowing its banks.
- Population pressure and urbanisation – In cities, certain building materials and substances are impermeable – tar, concrete and roofing materials – leading to rapid surface runoff. This increases the risk of a river overflowing its banks. Furthermore, vegetation is removed in cities.



Floods

4.3 Flood hydrographs

- A hydrograph is a graph that shows the discharge of a river over a period of time.
- Discharge is a measure of the amount of water passing a particular point per second. It is usually measured in cumecs or cubic metres per second.



Interpretation of the graph above:

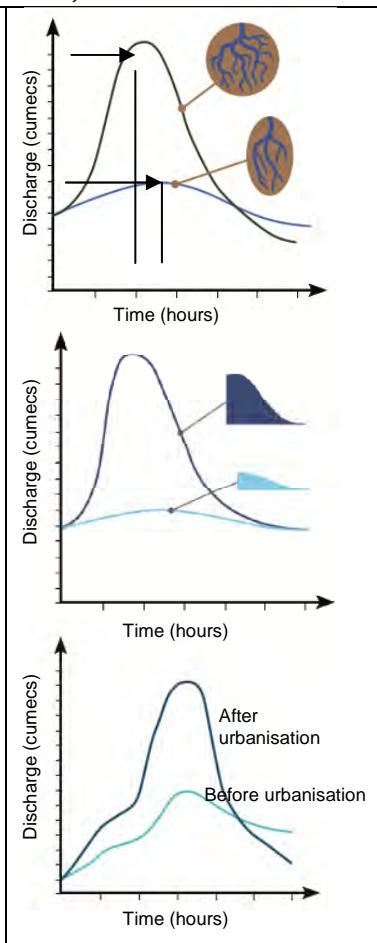
- More than 24 hours pass before the river drainage reaches a peak.
- Lag time is the gap in time between when the greatest amount of rain fell and the time when the greatest amount of water was discharged in the river (highest river level).

FACTORS INFLUENCING RIVER DISCHARGE AND FLOODS

- When a storm begins, the discharge in the river does not go up immediately.
- This is because only a little of the rain falls directly into the river.
- The first water to reach the river comes from runoff.
- More water is added to the river from throughflow – sometimes called baseflow. It is the movement of water downhill under the ground.
- Collectively, this increase in discharge is shown by the rising limb of the graph.

Rivers with short lag times and high discharge are more likely to flood than rivers with a long lag time and low discharge. Floods associated with short lag times and high discharge are usually influenced by:

- Drainage basin shape – Water takes longer to reach the mainstream in a narrow river basin than in a large basin.
- Steepness of terrain – Steep hills cause water to run off them quickly and reach the river quickly. Water rises rapidly in a river. See the steep rising limb on the middle hydrograph.
- Influence of land use – The landscape surface has an influence on the shape of the hydrograph. More vegetation absorbs precipitation and allows evaporation to take place into the atmosphere. This reduces the amount of water available for overland flow. Where surfaces are im-



Floods

permeable to water (roads and pavements in urban areas) the amount of runoff into gutters and drains increases rapidly and water flow is quick.

4.4 Flood characteristics and flood management

4.4.1 Flood characteristics

- Floods cause the greatest number of weather-related deaths and large-scale damage.
- A serious and costly natural disaster, floods damage roads, farmlands and structures. They change people's lives and destroy businesses.
- Floods often are followed by water-borne diseases such as cholera (especially when water purification systems are destroyed) and malaria (mosquitoes breed in pools of water).

4.4.2 Flood risk management

Assessing the risk of flooding and then taking measures to reduce the threat of flooding.

Measures include:

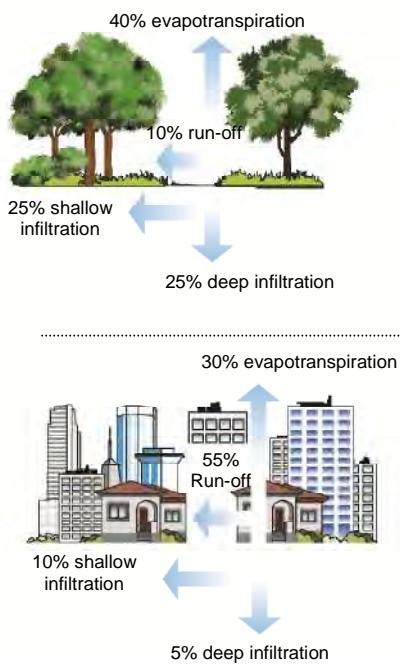
- Construction of flood defences.
- Creation of flood warning systems.
- Development of policies that reduce development in flood areas.

4.4.3 Flood management in rural areas

Execute a flood early warning system that:

- Forecasts the flood risk (water resource experts meet to plan).
- Detects and monitors flooding.
- Issues flood warnings.
- Team assesses flood situation to analyse information and assess.

Floods



In which sketch is there a higher risk of flooding?
Compare evapotranspiration and infiltration rates provided in the sketch to support your answer.

MANAGING FLOODS IN URBAN AREAS

- No development on floodplains.
- Ensure enough storm water drains that are clear of litter/vegetation.
- Establish greenbelts to promote infiltration and reduce runoff.
- Maintain wetlands to absorb extra water and reduce its speed of flow.
- Warn residents of flood occurrences.
- Secure food and shelter availability for flood victims.

FLOOD MANAGEMENT IN INFORMAL SETTLEMENTS

- High-risk flood areas (low-lying).
- Forecasting the flood risk.
- Detect and monitor flooding.
- Issue flood warnings.
- Providing alternative accommodation for flood victims.
- Create awareness of the risk of flooding.

Water resources

Questions

Question 1

Refer to source A below and answer the questions that follow, for 28 marks.

SOURCE A

YOU MAGAZINE JANUARY 2011

The blame for the floods that have wreaked havoc in the southern hemisphere – across South America, South Africa and Australia, and further north in Sri-Lanka and the Philippines – can be laid at the door of a climate condition known as La Niña. La Niña is responsible for the erratic weather systems experienced worldwide lately and the recent floods have all the typical characteristics of La Niña.

El Niño and La Niña are the result of a natural process that occasionally occurs in the Pacific Ocean. It's known as the Southern Oscillation and is nature's way of trying to balance the equator and South Pole's water and air temperatures. When ice forms at the South Pole matter suspended in the water, such as plankton, isn't incorporated. The remaining water gradually becomes more dense and sinks to the bottom of the ocean.

The sun heats the seawater at the equator and warm surface water flows southwards while the cold water directly below on the ocean bed flows north, creating a circular effect between the equator and South Pole.

The precise cause of La Niña and El Niño is still not fully understood. What is known is that La Niña is the result of excessive cold water welling up; causing unusually cold conditions, while unusually warm water collects on the edge of the Pacific Ocean, resulting in unusually high rainfall. The condensation of the warm surface seawater results in the heavy downpours recently seen in Brazil, Australia and parts of Indonesia for instance.

Scientists use satellites and buoys to measure the water temperature and predict or trace La Niña.

A La Niña system occurs every three to five years and can last up to two years but on average lasts nine to 12 months. The interval between an El Niño and La Niña system can be anything from a year to 10 years.

- 1.1 What has been cited as the cause of the recent floods in South Africa and elsewhere on Earth? Providing evidence from the source. (6)
- 1.2 What is plankton and what valuable role does it play in the ocean? (4)
- 1.3 In what other ways does the ocean benefit us? (8)
- 1.4 How does the Benguela current benefit South Africa? (6)
- 1.5 Explain the terms condensation and flooding. (4)

Water resources

Question 2

Refer to source B below and answer the questions that follow, for 22 marks.

SOURCE B



- 2.1 Describe the devastating effects of flooding on human life, the natural environment, health conditions and the economy of the affected countries. (8)
- 2.2 Describe an effective flood management strategy in urban, as well as in informal settlements. (8)
- 2.3 Write a short response on how you felt when you read that rescue workers heard muffled cries for help from a man who was trapped 4 metres under mud for 16 hours. (6)

Exam Papers

Answers to Questions

- 1.1 La Nina – A natural process of cold dense water sinking to the bottom of the ocean and moving equator-ward. Excessive water wells up causing cold conditions while surface warm water is pushed up along the edge of the Pacific ocean causing warm air to cool, condense and create rainfall that leads to flooding. (6)
- 1.2 Plankton provides oxygen and a source of food to all sea life that feeds on it. (4)
- 1.3 The ocean provides a source of fishing and energy, trade and tourism. In South Africa, we benefit from a multi-million rand fishing industry due to the cold Benguela current on the west coast; and a world renowned tourist destination – Durban – on the east coast due to the warm Agulhas current. (8)
- 1.4 Fish harvest comes from oceans with cold currents. South Africa's fishing industry is worth about R2 billion annually. It employs about 30 000 people. A large percentage of our fish comes from the upwelling nutrient-rich waters of the cold Benguela current. The cold nutrient-rich waters of the Benguela current rise up when the south-easterly winds blow the surface water to the north-west. (6)
- 1.5 Condensation – the change from water vapour to water droplets. Flooding – water sources (dams, rivers) overflowing. (4)
- 2.1 Fatalities – Brazil 700 deaths, 100s missing; South Africa – 400 dead, 8 missing. Natural Environment – removal of fertile soil, increased soil erosion from mudslides, silting of dams. Health – breakout of diseases, malaria, malnutrition, starvation. Economy – loss of infrastructure and agricultural production, millions to billions lost in recreating and rebuilding, affects exports of goods, unemployment increases. (8)
- 2.2 Managing floods in urban areas (any two): No development on floodplains, ensure enough storm water drains that are clear of litter/vegetation, establish greenbelts to promote infiltration and reduce runoff, maintain wetlands to absorb extra water and reduce its speed of flow, warn residents of flood occurrences, secure food and shelter availability for flood victims. (4)
Flood management in informal settlements (any two): High risk flood areas (low-lying), forecasting the flood risk, detect and monitor flooding, issue flood warnings, providing alternative accommodation for flood victims, create awareness of the risk of flooding. (4)
- 2.3 Sad, desperate to rescue him and reunite him with his family, anguish about his isolation from his family and the thought that he could have died had rescue workers not heard him. Finally, relief, that he was heard and rescued. (6)

Question paper 1

1

Answer any THREE questions.

SECTION A

QUESTION 1

1.1 Choose the correct term from those given in brackets to make all the statements TRUE, climatic point of view.

1.1.1 The (troposphere / thermosphere) is the most important layer of the atmosphere from a

climatic point of view.

1.1.2 The (thermosphere / stratosphere) is found between the troposphere and the mesosphere.

1.1.3 A low temperature of -90°C is reached in the (mesosphere / stratosphere).

1.1.4 Carbon dioxide and (water vapour / hydrogen) in the atmosphere is responsible for the

absorption of energy.

1.1.5 The ozone layer absorbs the (X-rays / ultraviolet rays) of the sun.

1.2 Fill in the missing words.

1.2.1 The ongoing process of making, breaking down and remaking of one type of rock into

another is called the _____.

Pressure and weathering turn igneous rocks into _____ rocks.

1.2.3 _____ rocks are formed when magma rises through the crust, cools and crystallises.

1.2.4 Marble is an example of a(n) _____ rock.

1.2.5 Sedimentary rock is built up in _____.

1.3 Refer to the synoptic weather map in FIGURE 1.3 and answer the following questions.

1.3.1 Find TWO characteristics on the synoptic weather map that indicate the weather map is illustrating summer conditions.

1.3.2 You are travelling by yacht (sail boat) from Cape Town to Port Elizabeth. Do you think the wind direction and wind speed is favourable for your voyage? Motivate your answer.

1.3.3 Compare the temperatures at Maputo and Luderitz.

(a) Which one of the two has the highest temperature?

(b) Account for the difference in temperature.

1.3.4 Give the following weather conditions at Durban:

(a) Cloud cover

(b) Dew point temperature

(c) Wind speed

(d) Temperature

1.4 Study the game in FIGURE 1.4 and answer the following questions. You do not need to know how to play the game to answer the questions. You can get all your answers from FIGURE 1.4.

1.4.1 Define the concepts in blocks 7 and 15.

1.4.2 Give TWO characteristics of the cloud in block 23.

1.4.3 Which one of the rainfall types in blocks 18 and 21 is found:

(a) during winter in the Western Cape?

(b) during summer in the interior of South Africa?

1.4.4 Use blocks 2, 9, 22 and 26 as a guide and describe how the type of rainfall in block 18 occurs.

1.5 Study FIGURE 1.5 showing a cross section of a landscape with fault lines.

1.5.1 Identify the feature at 1.

1.5.2 Describe how the feature mentioned in 1.5.1 was formed.

1.5.3 Identify the feature at 2.

1.5.4 Describe how the feature mentioned in 1.5.3 was formed.

1.5.5 Identify the type of fault at 3.

1.5.6 Redraw the type of fault at 3. Add the following labels to your diagram:

(a) Name the forces involved and add arrows showing the direction of the force

(b) Fault plane

1.6 FIGURE 1.6 shows the chief types of volcanic form. Answer the following questions.

1.6.1 Identify the landforms at A, B, and C.

1.6.2 Are these landforms intrusive or extrusive forms? Give ONE reason for your answer.

1.6.3 Study the intrusions C and D.

(a) How do the shapes of C and D differ from one another?

(b) Give one similarity with regard to landforms C and D.

1.6.4 Write an essay in which you explain what positive and negative effects the volcano in the diagram could have on a settlement nearby.

QUESTION 2

2.1 Define the following:

2.1.1 Relative humidity

2.1.2 Albedo

2.1.3 Saturation point

2.1.4 Greenhouse gases

2.1.5 Constant gases

2.2 State whether the following statements are true or false.

2.2.1 Collision margins cause severe earthquakes, but no volcanic eruptions.

2.2.2 The San Andreas Fault in California is an example of a constructive margin.

2.2.3 The Himalayas are being formed at a collision margin.

2.2.4 Continental plates are thicker and made of heavier material than oceanic plates.

2.2.5 Oceanic crust moves towards continental crust at destructive margins.

2.3 Study the advertisement, FIGURE 2.3, regarding coffee and climate change and answer the questions that follow.

2.3.1 Which of the following is the correct latitude of Kilimanjaro?

(a) 3° S

(b) 63° S

2.3.2 If only latitude is taken into account, explain why it is impossible for Kilimanjaro to have an icecap.

2.3.3 Account for the presence of the ice cap on Kilimanjaro.

2.3.4 Name the TWO gases that are responsible for this vertical change in temperature.

2.3.5 Would the north-facing or south-facing slope of Kilimanjaro be warmer? Give ONE reason for your answer.

2.3.6 Define global warming.

2.3.7 What is the impact of global warming on the organic coffee farmers on the slopes of Kilimanjaro?

2.3.8 You are part of the Woolworths campaign to make people aware of the threat of global warming on Africa. Write a newspaper article entitled 'Global warming: Africa beware' in which you outline the threats of global warming to the continent.

2.3.9 List TWO ways in which the impact of global warming on Africa can be reduced.

2.4 'Clouds is a large collection of tiny drops of water or ice crystals.' Answer the following questions.

2.4.1 Explain how clouds are formed.

2.4.2 Give TWO characteristics of stratus clouds.

2.5 Study FIGURE 2.5 showing the movement of continents over time and answer the questions that follow.

2.5.1 Who can be regarded as the father of the theory of drifting continents?

2.5.2 Give the name of the one large continent containing A and B in FIGURE 2.5.

2.5.3 Give the names of the two continents A and B into which the large one has divided.

2.5.4 How does continental drift differ from plate tectonics?

2.5.5 Give FIVE pieces of evidence that support the process shown in the diagram.

2.6 Study the information below regarding the Haiti and New Zealand earthquakes and answer the questions that follow.

Date	12 January 2010	4 September 2010
Where	Haiti	New Zealand
City	Port-au-Prince	Christchurch
X	7	7.1
Total deaths	220 000	1 of a heart attack

2.6.1 What scale was used to compare the intensity of the two earthquakes?

2.6.2 Which earthquake had a slightly stronger intensity?

2.6.3 Name the instrument that was used to measure the seismic waves of the earthquakes.

2.6.4 Account for the greater number of deaths in the earthquake in Haiti.

2.6.5 Explain how these earthquakes could have affected the people of Haiti and New Zealand.

QUESTION 3

3.1 Choose the correct word in brackets.

3.1.1 (Fertility rate / life expectancy / natural increase) is the number of years that an average person may expect to live.

3.1.2 (Fertility rate / life expectancy / natural increase) is the average number of children a woman will have in her lifetime.

3.1.3 (Fertility rate / life expectancy / natural increase) = Birth rate – Death rate.

3.1.4 If the death rate is higher than the birth rate, the growth rate will be (positive / negative / stable).

3.1.5 The greater the positive difference in birth and death rate, the (faster / slower) the rate of population growth.

3.2 Study the demographic transition model in FIGURE 3.2. Which one of the stages 1 to 5 of the demographic cycle is described by the following statements? Write only the stage number (1, 2, 3, 4 or 5) next to the question number (3.2.1 to 3.2.5).

3.2.1 Death rate drops, but birth rate remains high

3.2.2 Slow natural increase

3.2.3 Both birth and death rates are high

3.2.4 Brazil is in this stage

3.2.5 Low birth and death rates

3.3 Figure 3.3 represents the distribution of population over the world. Answer the following questions.

3.3.1 Define population distribution.

3.3.2 Why can the population distribution of the world be described as uneven?

3.3.3 Why are the regions A, B and C sparsely populated?

3.3.4 Would you describe the distribution in the developing world as crowded or sparsely populated?

3.3.5 Explain why a dense population distribution is found at D.

3.4 Study figure 3.4 that represents a kind of population movement and answer the questions that follow.

3.4.1 Identify the population movement in the diagram.

3.4.2 Would you regard this movement as forced or voluntary migration? Give ONE reason for your answer.

(a) Define a pull factor. (1×2)

(b) Give TWO pull factors in the city on the diagram.

3.4.3 Give TWO push factors experienced by teenagers in the rural areas on the diagram.

3.4.4 Give THREE consequences the rural areas will experience if a large number of people leave the rural area.

3.4.5 One of the people in the rural area mentions a lack of work in the rural area as a push factor. Write an essay in which you describe the problems this person could experience if he/she decides to move to the city.

4

3.5 The graph in FIGURE 3.5 represents a study regarding population growth done in southern Asia. Answer the following questions.

(4)

Why did the region experience a slow natural population increase in 1590?

(2×2)

In which year did the rapid increase in population in southern Asia begin?

(4)

Why did the population increase rapidly at this time?

(3×2)

Give TWO problems described on the graph that the region will face if this tendency continues after 2010.

(4)

Why is it important that the region should move from a J-curve to an S-curve of population growth?

(2)

What can be done to manage population growth in the region?

(30)

/100/

QUESTION 4

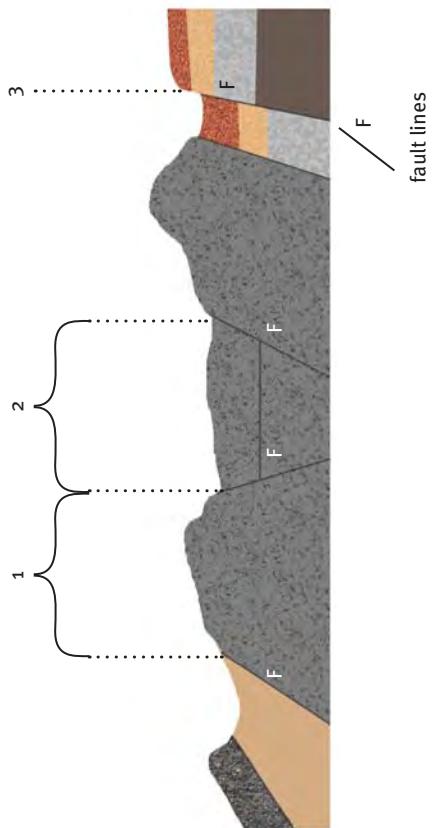
(2)

QUESTION 4

(10)

Diagrams

FIGURE 1.5



2

FIGURE 1.6

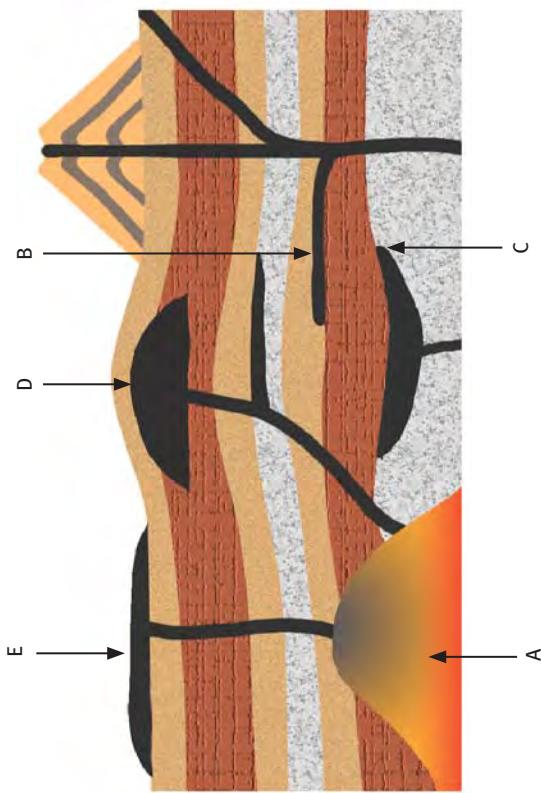
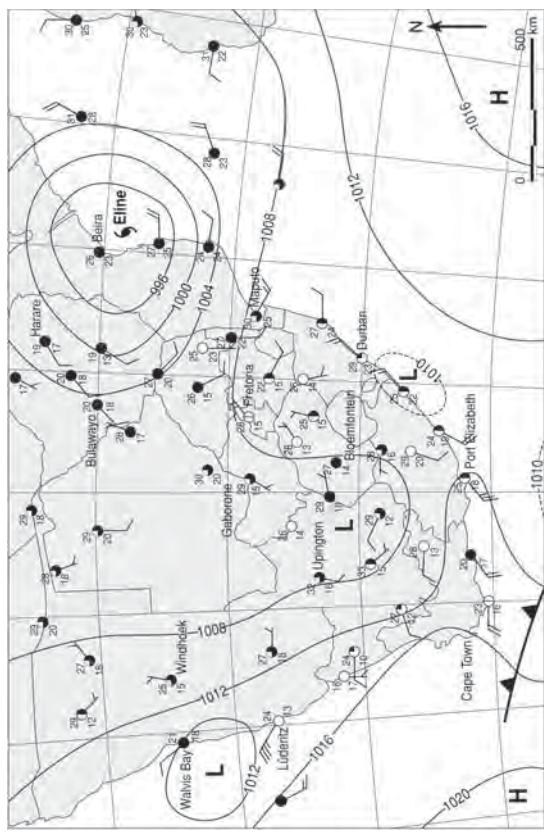


FIGURE 1.3



1

FIGURE 1.4

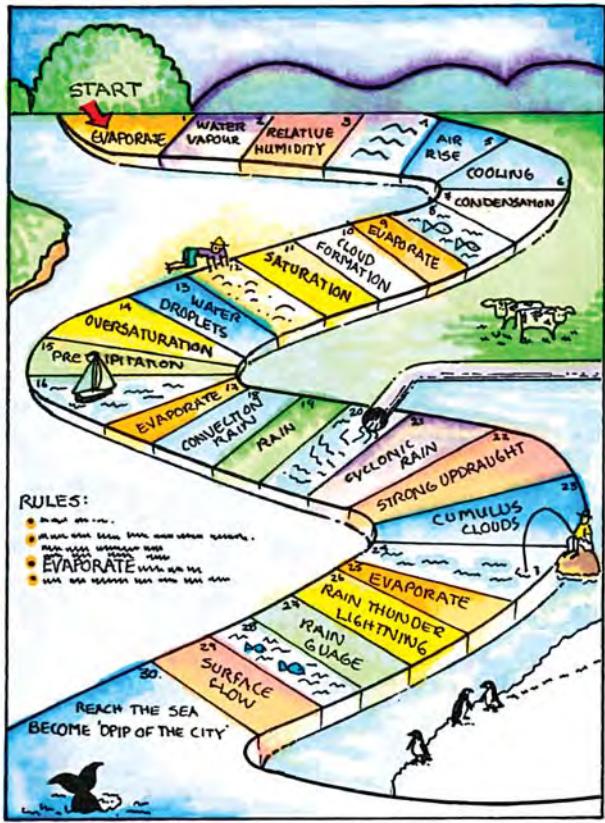
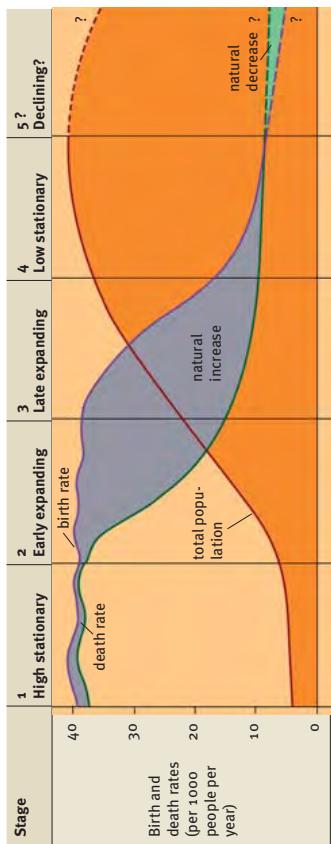
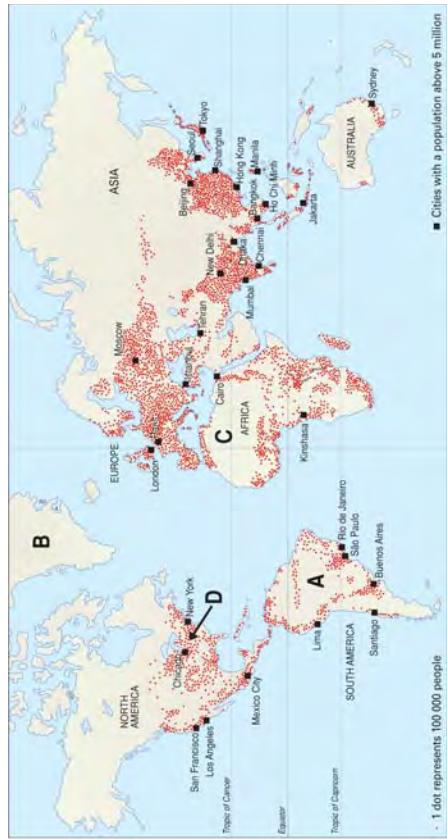
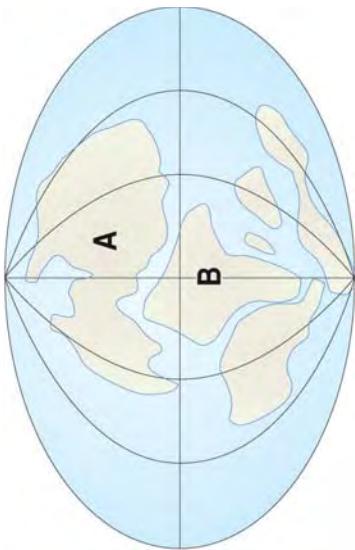
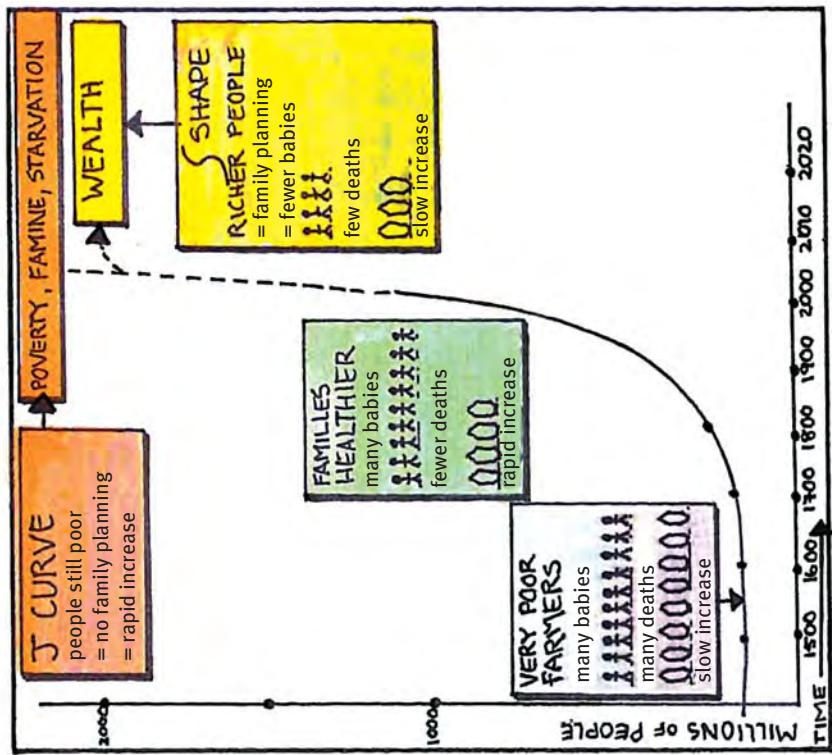


FIGURE 2.3**FIGURE 3.2****FIGURE 3.3****FIGURE 2.5**

Diagrams

6

FIGURE 3.5



5

FIGURE 3.4

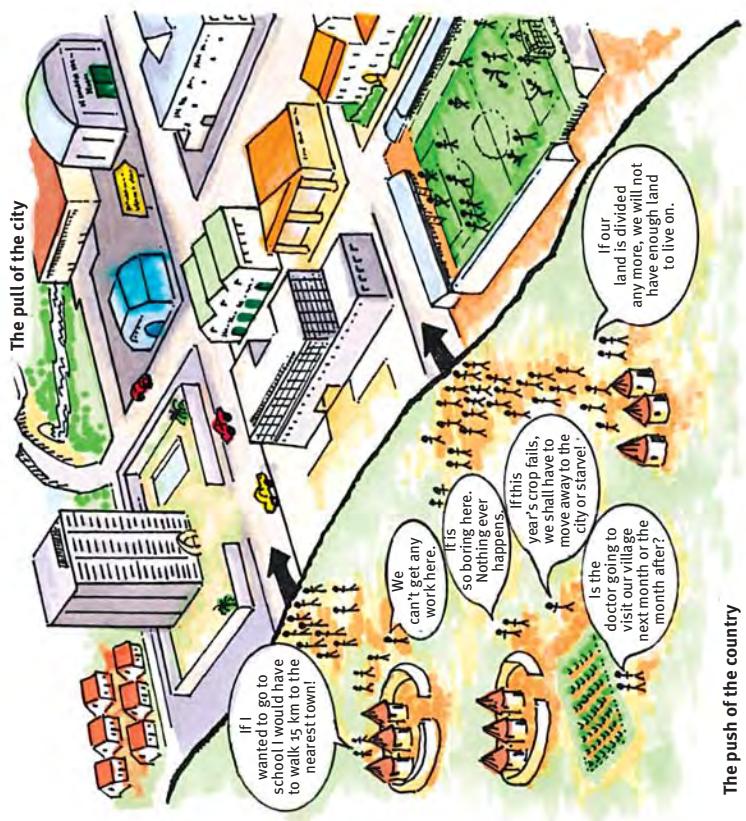
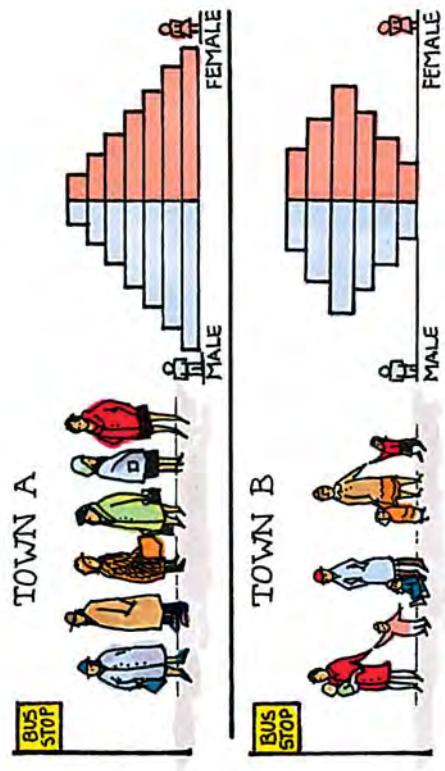
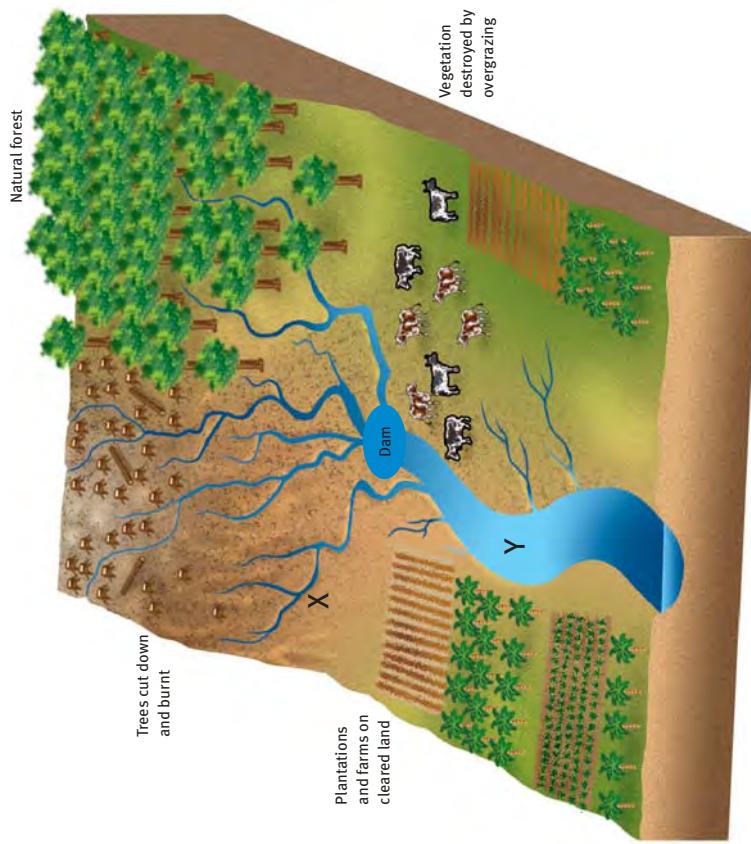


FIGURE 4•3**FIGURE 4•5****FIGURE 4•4**

Young, gifted and DEAD HORRIBLE TRUTH:

In SA young people are dying before their parents

THESE shocking graphs show how the number of South African men who die before they reach the age of 50 almost doubled over the past 10 years – an increase attributed directly to HIV/AIDS.

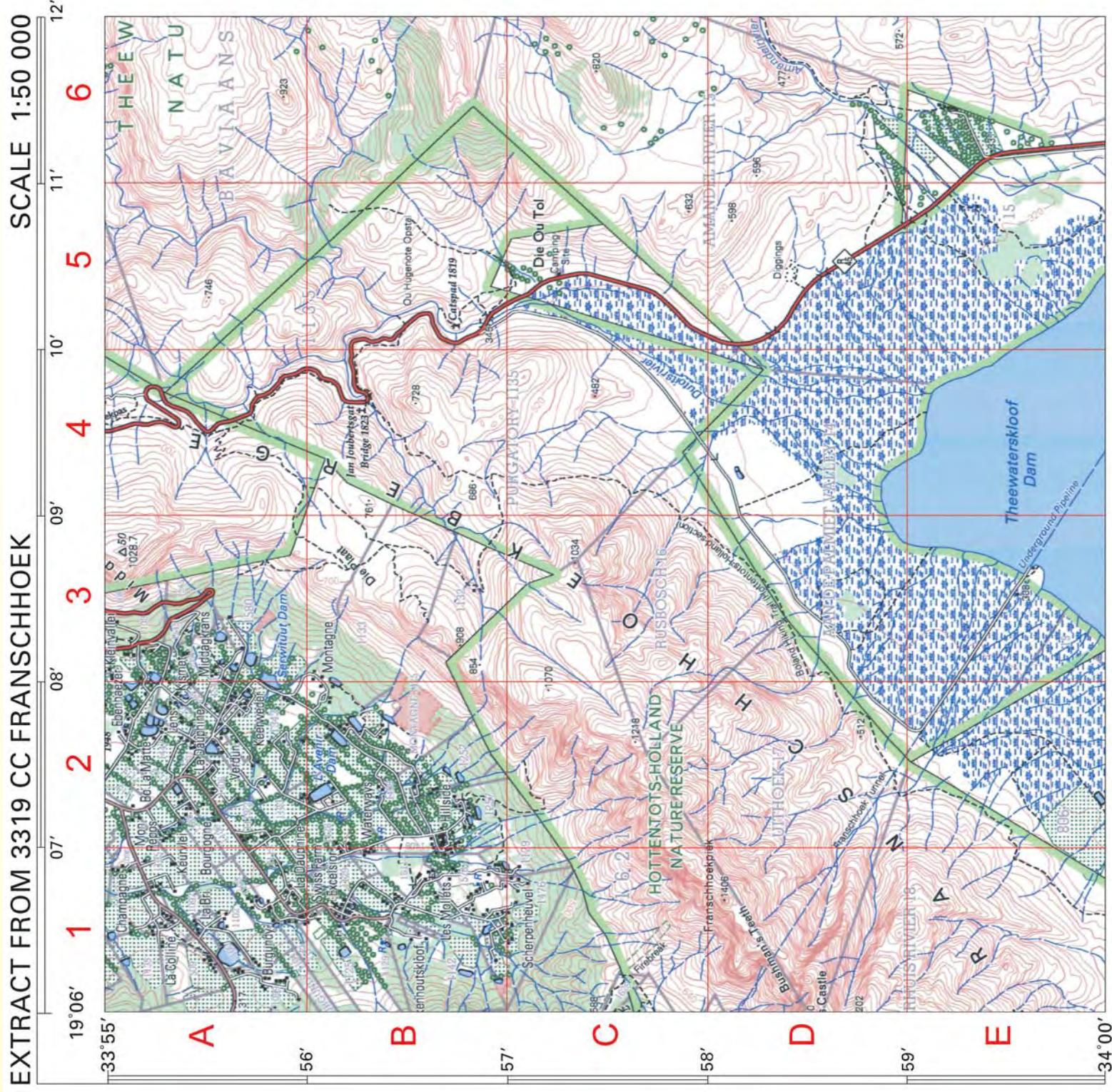
The figures, were presented to stunned members of Thabo Mbeki's advisory panel on AIDS on Tuesday by the president of the Medical Research Council, Professor Makgoba.

"A major war would be the only other thing that could explain the high numbers South Africans:

- An estimated R72 billion was spent on educating those of a productive age who died of AIDS in 1999–2000;
- By 2003 12% of highly skilled workers, 26% of skilled workers and 27.2% of low-skilled workers will be infected. It will cost an estimated R250 000 to replace each skilled labourer lost.
- It will cost the public health system R1 900 a year to treat each AIDS patient.

Adapted from an article in *The Sunday Times*.

Question paper 2



Study the extract from the 1:50 000 topographic map called 3319 CC Franschhoek. Also study the aerial photograph that covers the whole of the mapped area on a different scale.

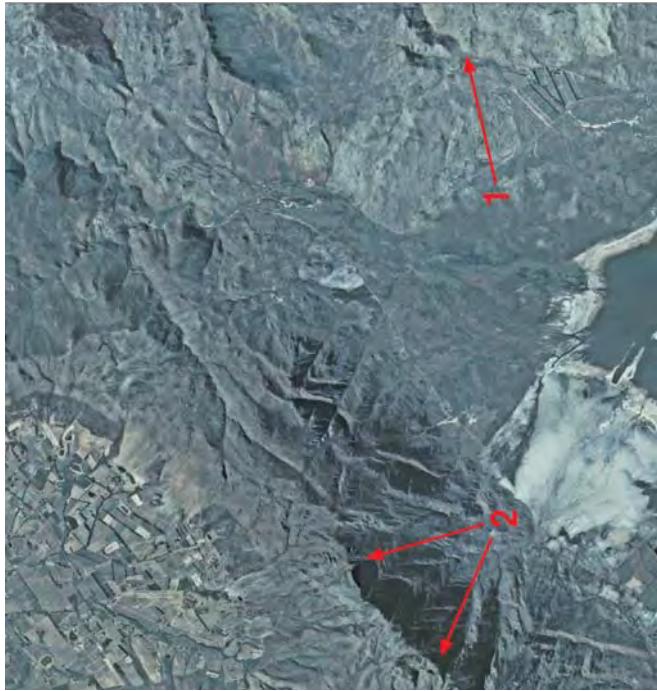
- 1 Locate Franschhoek on a map of South Africa.
 - a In which province is Franschhoek? (1x2) (2)
 - b Which province has this as its southern neighbour? (1x2) (2)
- 2 Map skills using the 1:50 000 topographical map:
 - a Express the scale of 1:50 000 in words. (1x2) (2)
 - b Which has the larger scale, the topographic map or the aerial photograph? (1x2) (2)
 - c State the latitude of spot height 1406 (D2). (1x2) (2)
 - d State the longitude of Jan Joubertsgat Bridge (B5). (1x2) (2)
 - e The river in E4 flow mainly towards the _____. A north-west; B south-east; C south-west; D north-east (1x2) (2)
 - f Give TWO pieces of evidence that show that the road numbered R45 (from E7 to A5) is a very old road. (2x2) (4)
- 3 Map skills using the aerial photograph and topographical map:
 - a State whether this aerial photograph is oblique or vertical. (1x2) (2)
 - b What is the name of the river marked 1 on the aerial photograph? (1x2) (2)
 - c What is the name given to the feature marked 2 – 2 on the aerial photograph. (1x2) (2)
 - d The feature marked 2 is a _____. (1x2) (2)

A convex slope, B concave slope, C saddle, D ridge

The names 'Hottentot' (Hottentots-Holland Nature Reserve in C2 and C3) and 'Bushman' (Bushman's Teeth in D2) were the names given to original inhabitants of the area but are now considered to be unacceptable. Suggest new names for these two features. (2x2) (4)
- 4 It has been suggested that the area north-east of the Theewaterskloof Dam in D5 should be turned into a fruit farming area. It is estimated that this could provide jobs for over 200 disadvantaged people. The money could be provided by the state.
 - a List THREE GIS layers that the planners would have to use when carrying out the survey. (3x2) (6)
 - b Explain fully why people will have different opinions about whether this scheme should go ahead. (4x2) (8)

The Theewaterskloof Dam is part of an inter-basin water transfer scheme.
- 5 a What is meant by the term inter-basin transfer? (2x2) (4)
- b What evidence is there of an inter-basin transfer scheme in the area? (1x2) (2)
- 6 Give ONE of each of the following types of symbols found in block D5
 - a Point (3x2) (6)
 - b Line
 - c Area(polygon)
- 7 8 Which of the blocks B3 and A2 is:
 - a Sparsely populated (4x2) (8)
 - b Densely populated

Give a reason for your answer in each case.
- 9 Why can snow be expected in block D1 during winter? (1x2) (2)
- 10 In the Southern Hemisphere, the sun always shines from a northerly direction. Explain why it will be cooler on the hiking trail in block C2 than in Block D3. (2x2) (4)



Answer Papers 1 and 2

Paper 1

/100/

QUESTION 1

- 1.1
 1.1.1 Troposphere✓✓
 1.1.2 Stratosphere✓✓
 1.1.3 Mesosphere✓✓
 1.1.4 Water vapour✓✓
 1.1.5 Ultraviolet rays✓✓ (5x2)

(10)
 [10]

- 1.2
 1.2.1 Rock cycle✓✓
 1.2.2 Metamorphic✓✓
 1.2.3 Igneous✓✓
 1.2.4 Metamorphic✓✓
 1.2.5 Layers✓✓ (5x2)

(10)
 [10]

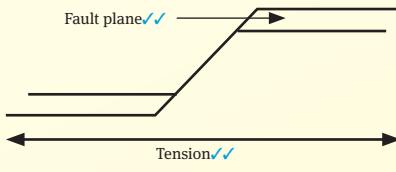
- 1.3
 1.3.1 High temperatures✓✓ Tropical cyclone Eline✓✓
 High cloud cover over the interior✓✓ (Any TWO) (2x2)
 1.3.2 Yes✓✓ Wind from west to south-west✓✓ Wind speed at least 20 knots✓✓
 1.3.3 (a) Maputo✓✓
 (b) Warm current✓✓ (2x2)
 1.3.4 (a) ✓✓
 (b) 23 °C✓✓
 (c) 15 knots✓✓
 (d) 29 °C✓✓ (4x1)

(4)
 [18]

- 1.4
 1.4.1 Condensation: The physical process in which a vapour becomes a liquid✓✓
 Precipitation: Water particles, liquid or solid, that fall down through the atmosphere and reach the surface of the Earth✓✓ (2x2)
 1.4.2 Thunder✓✓ Lightning✓✓ Dark grey✓✓ Rain✓✓ (Any TWO) (2x2)
 1.4.3 (a) 21✓✓
 (b) 18✓✓ (2x2)
 1.4.4 Water evaporates✓✓ creating water vapour. Rising air currents carry the water vapour upwards✓✓. Strong updraughts result in cooling✓✓. Cumulonimbus clouds form✓✓. Convectional rain occurs with rain, thunder and lightning✓✓. (5x2)

(10)
 [22]

- 1.5
 1.5.1 Horst✓✓ (1x2)
 1.5.2 A horst is formed by forces of compression✓✓ in which blocks are pushed together and the centre part between roughly parallel faults rises to form a mountain✓✓. (2x2)
 1.5.3 Rift valley✓✓ (1x2)
 1.5.4 A rift valley is formed by forces of tension✓✓ in which blocks are pulled apart and the centre part between roughly parallel faults drops down to form a valley✓✓. (1x2)
 1.5.5 Normal fault✓✓ (1x2)
 1.5.6



(2x2) (4)
 [16]

- 1.6
 1.6.1 A Batholith✓✓
 B Sill✓✓
 C Lopolith✓✓ (3x2)
 1.6.2 Intrusive✓✓ Formed below the surface of the Earth✓✓ (2x2)
 1.6.3 (a) C is saucer-shaped and D is mushroom-shaped✓✓
 (b) Both are connected to a magma source by means of a pipe✓✓ (2x2)
 1.6.4 **Positive:** Tourist attraction✓✓ Diamonds in volcanic pipes✓✓ Fertile soil✓✓ Hot springs (from very hot underground water)✓✓ Electricity generated from very hot underground water✓✓
Negative: People killed✓✓ Possessions destroyed✓✓ Water polluted✓✓ Toxic gases given off✓✓ Buildings damaged or destroyed✓✓
 (At least TWO of both Positive and Negative) (5x2)

(10)
 [24]

QUESTION 2

- 2.1
 2.1.1 The percentage of water vapour in the air relative to the amount of water vapour that would be present in the air if the air were saturated at the same temperature✓✓
 2.1.2 The reflective capability of a surface✓✓
 2.1.3 The point at which no more water can be absorbed✓✓
 2.1.4 Gases that absorb radiation and contribute to the heating of the atmosphere✓✓
 2.1.5 Atmospheric gases that have stable concentrations✓✓ (5x2)

(10)
 [10]

- 2.2
 2.2.1 True✓✓
 2.2.2 False✓✓
 2.2.3 True✓✓
 2.2.4 False✓✓
 2.2.5 True✓✓ (5x2)

(10)
 [10]

- 2.3
 2.3.1 (a) ✓✓ (1x2)
 2.3.2 Too close to equator✓✓ (1x2)
 2.3.3 Very high✓✓ (1x2)
 2.3.4 Water vapour✓✓ Carbon dioxide✓✓ (2x2)
 2.3.5 North facing✓✓ in Southern Hemisphere✓✓ (2x2)
 2.3.6 Global warming is the process by which world temperatures are rising.✓✓ (1x2)
 2.3.7 Global warming melts the glacier, with the result that there is less water available for the farmers.✓✓ (1x2)
 2.3.8 Rise in sea levels✓✓ Droughts✓✓ Heat waves✓✓ Strong tropical storms✓✓ Landslides✓✓ Desertification✓✓ Floods✓✓ Melting Kilimanjaro ice cap✓✓ Threat to coral reefs✓✓ (any FIVE) (5x2)

(10)
 [30]

- 2.3.9 Maintain food security✓✓ Protect environment✓✓ Recycle and reuse✓✓ Use fuel-efficient cars✓✓ Use public transport✓✓ Plant trees✓✓ Educate✓✓ (Any TWO, accept other reasonable answers) (2x2)

(2)
 [10]

- 2.4
 2.4.1 Warm air rises✓✓, condensation occurs✓✓, tiny drops of water form✓✓ creating a visible cloud✓✓. (Any THREE) (3x2)

(6)

- 2.4.2 Flat and hazy✓✓ Low altitude✓✓ Dark grey to nearly white✓✓ May produce light drizzle✓✓ (2x2)
- 2.5
 2.5.1 Alfred Wegener✓✓ (1x2)
 2.5.2 Pangaea✓✓ (1x2)
 2.5.3 A Eurasia✓✓ B Gondwanaland✓✓ (2x2)
 2.5.4 Continental drift: Continents drifting apart Plate tectonics: More accurate description; plates cause continents to move✓✓ (1x2) (2)
 2.5.5 The east coast of South America and the west coast of Africa match well especially below sea level✓✓. The plant and animal life of these two continents is very similar✓✓. Glacial deposits in Brazil match those in West Africa✓✓. Identical fossil remains have been found in Africa, India and Antarctica✓✓. Rock formations match up across the coastlines of South Africa and South America✓✓. Antarctica has coal deposits from a plant called *Glossopteris*. Identical deposits have been found in South America, Africa, India and Australia.✓✓ (Any FIVE) (5x2)

(10)
 [10]

- 2.6
 2.6.1 Richter scale✓✓ (1x2)
 2.6.2 Christchurch✓✓ (1x2)
 2.6.3 Seismograph✓✓ (1x2)
 2.6.4 No early warning system in Haiti✓✓. Better medical services in New Zealand✓✓. (2x2)
 2.6.5 People may be injured or killed✓✓. Buildings may be damaged or collapse✓✓. Electricity, gas and water supplies may be disrupted✓✓. Water pipes may break✓✓. Dam walls may break and cause landslides and mudslides✓✓. There may be a shortage of fresh drinking water✓✓, food and medical supplies✓✓. Industries may be forced to close✓✓. Disease may break out✓✓. Tsunamis may hit the land✓✓. (Any FIVE) (5x2)

(4)
 [10]
 [20]
 /100/

QUESTION 3

3.1		4.3.5 Town B✓✓	
3.1.1 Life expectancy✓✓		More people in the age group 20–35✓✓ Their children will have children of their own soon✓✓ 2+(2x2)	(6)
3.1.2 Fertility rate✓✓		4.3.6 A: Triangular✓✓ Broad base, gets narrow towards the top✓✓	(8)
3.1.3 Rate of natural increase ✓✓		B: Bell-shaped✓✓ Narrow base✓✓ (4x2)	(8)
3.1.4 Negative✓✓		4.3.7 No✓✓	
3.1.5 Faster✓✓ (5x2)	(10) [10]	The triangular pyramid fits town B✓✓ The bell-shaped pyramid fits town A✓✓ 2+(2x2)	(6) [28]
3.2		4.4	
3.2.1 2✓✓		4.4.1 Because of HIV and AIDS✓✓ (1x2)	(2)
3.2.2 1 or 4 ✓✓		4.4.2 War✓✓ (1x2)	(2)
3.2.3 1✓✓		4.4.3 R7.2 billion was spent on educating those who have died✓✓. It will cost R250 000 to replace each skilled labourer lost✓✓. It costs the public health system R16 000 a year to treat each patient✓✓. (3x2)	(6)
3.2.4 3✓✓		4.4.4 Millions of adults have died✓✓ Children have died✓✓ Life expectancy has dropped✓✓ (3x2)	(6)
3.2.5 4 or 5 ✓✓ (5x2)		4.4.5 Education✓✓ Abstinence of young people✓✓ Use of Condoms✓✓ Being faithful to your partner✓✓ Use of anti-retroviral medicines✓✓ Better medical facilities✓✓ Advertising campaigns✓✓ Knowing one's HIV status✓✓ Policies linked to schools and workplaces✓✓ (Any FIVE; accept other reasonable answers) (5x2)	(10) [26]
3.3		4.5	
3.3.1 The location of people in a geographical area✓✓ (1x2)		4.5.1 When a river overflows its banks or the sea overflows the coastline because of storms or tsunamis✓✓ (1x2)	(2)
3.3.2 Not the same density everywhere✓✓ (1x2)		4.5.2 (a) Y✓✓ (1x2)	(2)
3.3.3 A Tropical regions✓✓		(b) Many tributaries have joined✓✓ Floodplain✓✓ (2x2)	(4)
B Cold regions✓✓		(c) Trees cut down✓✓ Plantations and farms on cleared land✓✓ Vegetation destroyed by overgrazing✓✓ (3x2)	(6)
C Warm dry regions✓✓ (3x2)		4.5.3 The dam✓✓ (1x2)	(2)
3.3.4 Crowded✓✓ (1x2)		4.5.4 Build dams✓✓ Conserve wetlands✓✓ Build channels✓✓ Re-introduce vegetation✓✓ Divert water from settlements✓✓ Reinforce banks✓✓ Prevent settlements below flood line✓✓ (Any FIVE; accept reasonable answers) (5x2)	(10) [26]
3.3.5 Large urban area✓✓ Industries✓✓ Lots of employment✓✓ (3x2)			/100/
3.4		Paper 2	
3.4.1 Rural-urban migration✓✓ (1x2)			
3.4.2 Forced✓✓ when push factors are involved✓✓ OR Voluntary✓✓ when pull factors are involved (2x2)		1 a Western Cape✓✓ b Northern Cape✓✓	(2) (2)
3.4.3 (a) Factors that attract people to the city✓✓ (1x2)		2 a One centimetre on the map represents 500 m (or half a kilometre) on the ground, or two centimetres on the map represent 1 000 m (or 1 km) on the ground.✓✓	(2)
(b) Better work in buildings shown✓✓ Entertainment in cinema, hotel✓✓ Education – high school and university✓✓ Medical services – hospital✓✓ Recreation – soccer✓✓ (Any TWO. NB: 'Buildings' alone not accepted) (2x2)		b The topographic map has the larger scale.✓✓	(2)
3.4.4 School far from home✓✓ Boring✓✓ (2x2)		c 33°58'05"S✓✓	(2)
3.4.5 Older people left to do the hard work✓✓ Lack of hope and initiative✓✓ Farms become neglected and abandoned✓✓ Decrease in productivity in primary sector✓✓ Schools close✓✓ Shops close✓✓ (Any THREE) (3x2)		d 19°09'40"E (allow about 5" either way for the latitude and longitude)✓✓	(2)
3.4.6 Shortage of jobs✓✓ Crime✓✓ Drugs✓✓ Prostitution✓✓ Shortage of housing✓✓ Land and noise pollution✓✓ Disease✓✓ Congestion✓✓ (Any FIVE; accept other reasonable answers) (5x2)		e B: south-east✓✓	(2)
3.5		f Any two of: Jan Joubertsberg Bridge 1823; Die Ou Tol; Catspad 1819. (Do not accept bendy/curvy road.)✓✓	(2)
3.5.1 Very poor farmers✓✓ Many deaths✓✓ (2x2)		3 a Vertical✓✓ b Bierrivier✓✓ c Bushman's Teeth✓✓ d D: ridge✓✓	(2) (2) (2) (2)
3.5.2 Accept 1800–1850✓✓ (2x2)		4 Any acceptable names✓✓	(4)
3.5.3 Healthier families✓✓ Many babies✓✓ Fewer deaths✓✓ (3x2)		5 a Any three of: soils; rainfall; geology; relief; vegetation; communication routes; dam position; plus other acceptable themes	(6)
3.5.4 Poverty✓✓ Famine✓✓ Starvation✓✓ (Any TWO) (2x2)		b Points for: provide jobs; bring money to the area; roads will be built; housing will be provided (2x2)	(4)
3.5.5 Could lead to wealth✓✓ (1x2)		Points against: part of the area is in a nature reserve; most is in a wetland; agricultural chemicals will pollute the dam; the high water table could flood the crops (2x2)	(4)
3.5.6 Family planning✓✓ Educate people✓✓ Government policies✓✓ Limit families to one child✓✓ Later marriages✓✓ Sterilisation✓✓ Abortion✓✓ (Any FIVE; accept other reasonable answers) (5x2)		6 a In an inter-basin transfer scheme, water is taken from one drainage basin which has an excess of water✓✓ to another basin where there is a greater need for water.✓✓	(4)
	(10) [30] /100/	b Any one of: underground pipeline (E4, E5) or Franschhoek tunnel (D3 to C1).	(2)
4.1		7 a Spot height or✓✓ b Non-perennial river or arterial road or row of trees or nature reserve boundary✓✓	(2)
4.1.1 The movement of people in which they leave their home country in order to settle down and work in another country✓✓		c Marsh or Diggings or Hottentots Holland Nature Reserve✓✓ (3x2)	(6)
4.1.2 The movement of people within a country✓✓		8 a B3✓✓ Steep slopes✓✓ b A2✓✓ Valley✓✓ (4x2)	(8)
4.1.3 People who have been forced to leave their home country for fear of persecution✓✓		9 Very high or Altitude✓✓ (1x2)	(2)
4.1.4 A person who moves for employment reasons✓✓		10 On southern side of mountain✓✓ Sun's rays blocked by mountain✓✓ (2x2)	(4)
4.1.5 Migration against a person's will as a result of circumstances beyond that person's control✓✓ (5x2)			
4.2			
4.2.1 False✓✓			
4.2.2 True✓✓			
4.2.3 False✓✓			
4.2.4 True✓✓			
4.2.5 True✓✓ (5x2)			
4.3			
4.3.1 Town A✓✓ (1x2)			
4.3.2 Town B✓✓ (1x2)			
4.3.3 Town B✓✓ (1x2)			
4.3.4 More younger adults in Town B✓✓ (1x2)			