

GRADE

12

CAPS

3 in 1

Geography

Susan Rushton

1

Notes

2

Questions and Memos per Module

3

Mapwork

Orthophoto and colour Topographical Map included

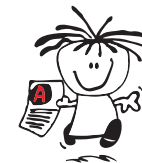
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GRADE 12 EXAMINATION OUTLINE

MID-YEAR	
PAPER 1	PAPER 2
Marks: 225 Time: 3 hours Learners must answer three questions.	Marks: 75 Time: 1½ hours
Section A:	Question 1 15 marks Multiple choice questions
Question 1 75 marks	Question 2 20 marks Map calculations
▶ Short objective type questions for 15 marks to cover content on Climate and Weather and Geomorphology ▶ Climate and Weather for 30 marks ▶ Geomorphology for 30 marks	Question 3 25 marks Analysis and interpretation of a topographical map and an orthophoto map, and application of theory
Question 2 75 marks	Question 4 15 marks GIS
▶ Short objective type questions for 15 marks to cover content on Climate and Weather and Geomorphology ▶ Climate and Weather for 30 marks ▶ Geomorphology for 30 marks	
Section B:	
Question 3 75 marks	
▶ Short objective type questions for 15 marks to cover content on Rural and Urban settlement ▶ Rural settlement for 30 marks ▶ Urban settlement for 30 marks	
Question 4 75 marks	
▶ Short objective type questions for 15 marks to cover content on Rural and Urban settlement ▶ Rural settlement for 30 marks ▶ Urban settlement for 30 marks	



TRIAL AND END-OF-YEAR	
PAPER 1	PAPER 2
Marks: 225 Time: 3 hours Learners must answer any three questions.	Marks: 75 Time: 1½ hours
Section A:	Question 1 15 marks Multiple choice questions
Question 1 75 marks	Question 2 20 marks Map calculations
▶ Short objective type questions for 15 marks to cover content on Climate and Weather and Geomorphology ▶ Climate and Weather for 30 marks ▶ Geomorphology for 30 marks	Question 3 25 marks Analysis and interpretation of a topographical map and an orthophoto map, and application of theory
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Section B:	
Question 3 75 marks	
▶ Short objective type questions for 15 marks to cover content on Settlement and Economic Geography ▶ Settlement Geography for 30 marks ▶ Economic Geography for 30 marks	
Question 4 75 marks	
▶ Short objective type questions for 15 marks to cover content on Settlement and Economic Geography ▶ Settlement Geography for 30 marks ▶ Economic Geography for 30 marks	



1: CLIMATE AND WEATHER

UNIT 1	MID-LATITUDE CYCLONES	4
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UNIT 3	SUBTROPICAL ANTICYCLONES AND THE RESULTANT WEATHER OVER SOUTH AFRICA	15
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REVISION FROM GRADE 11

GLOBAL AIR CIRCULATION

Atmospheric Pressure	pressure exerted by the weight of the atmosphere on the earth's surface
Isobars	lines on a weather map joining places with the same air pressure
Hectopascal (hPa)	unit of measurement for air pressure; normal sea level pressure is 1013 hPa
Low Pressure (LP)	an area where the atmospheric pressure is lower than that of the surrounding area; lows are associated with warm air and atmospheric lifting – because of this, lows normally produce clouds, precipitation and unstable conditions a low pressure cell is called a cyclone or a depression; air moves in a clockwise direction around a cyclone in the Southern Hemisphere
High Pressure (HP)	an area where the atmospheric pressure is higher than that of the surrounding area; highs are associated with cooler, subsiding air – because of this, highs normally produce clear (cloudless), dry and stable conditions a high pressure cell is called an anticyclone; air moves in an anticlockwise direction around an anticyclone in the Southern Hemisphere

The four global pressure belts

- ▶ **Equatorial low pressure zone** (5° N - 5° S): caused by high temperatures and therefore rising air throughout the year due to maximum solar insolation.
- ▶ **Subtropical high pressure zone** (30° - 40° N and S): associated with descending (sinking) air – not influenced by temperatures. At the subtropics the air cools and descends, creating areas of high pressure.
- ▶ **Subpolar low pressure zone** (60° - 70° N and S): associated with ascending (rising) air. Caused by convergence of air blowing out from the Polar and Subtropical high pressures.
- ▶ **Polar high pressure zone** (90° N and S): caused by the sinking of cold, dense air at the poles.

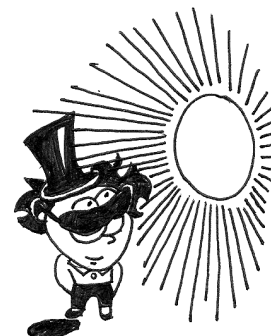
Pressure gradient

- ▶ **Pressure gradient:** the differences in atmospheric pressure across the earth's surface. The closer together the isobars are on a weather map, the stronger the wind; the further apart the isobars, the gentler the wind.
- ▶ As soon as air starts to move from high pressure to low pressure, it is **deflected**, and changes direction. This deflection is called the **Coriolis force**. Coriolis force exists as a result of the earth's rotation.
- ▶ The earth's rotational speed is faster at the equator than at the poles.
- ▶ As a result, a wind that blows from the equator towards the poles will have a greater speed. This causes the wind to deflect.
- ▶ According to **Ferrel's Law:** air is deflected to the **left** in the Southern Hemisphere and to the **right** in the Northern Hemisphere.
- ▶ The greater the speed of the wind, the greater the deflection.
- ▶ The Coriolis force is zero at the equator.

PRIMARY AIR CIRCULATION

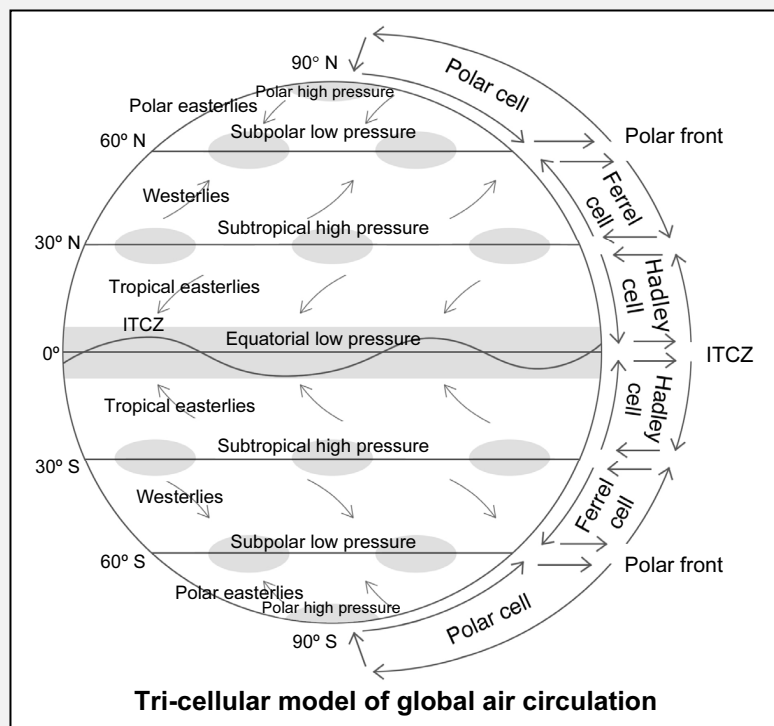
Primary air circulation is the transfer of heat energy on a large scale covering thousands of kilometres.

- ▶ Air movement is both horizontal and vertical.
- ▶ **Heat equator:** the hottest area where the sun's direct rays are shining.
- ▶ Different amounts of heat energy reach the earth at different times of the year. As a result, the position of the pressure belts and wind systems change – they are further **north** in the Northern Hemisphere summer (June/July) and move further **south** in the Southern Hemisphere summer (December/January).
- ▶ **Convergence zones:** form where air moves in towards an area of low pressure. Also leads to rising air.
- ▶ **Divergence zones:** form where air moves out from an area of high pressure.
- ▶ **ITCZ (Inter-Tropical Convergence Zone):** an area of convergence found where the tropical easterlies meet. Its position changes as the heat equator moves north or south of the equator. This area is also known as the 'doldrums'.



Tri-cellular circulation

There are three cells of circulation (tri-cellular) with general surface wind patterns.



► Hadley (tropical) cell (0° - 30° N and S)

Air rises at the equator to form the Equatorial LP belt and sinks at 30° N and S to form a HP belt, the Subtropical HP.

Surface winds move from the HP to LP areas as easterly winds: southeasterly winds (Southern Hemisphere) and northeasterly winds (Northern Hemisphere). These winds are often referred to as the 'trade' winds.

► Ferrel (mid-latitude) cell (30° - 60° N and S)

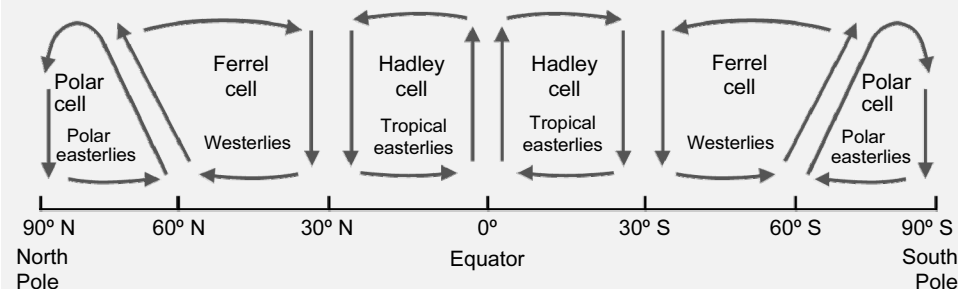
Air sinks in the HP belt at 30° N and S and rises at the Subpolar LP.

Surface winds move towards the poles as westerly winds: northwesterly winds (Southern Hemisphere) and southwesterly winds (Northern Hemisphere).

► Polar cell (60° - 90° N and S)

Air from the polar front regions sinks at 90° forming the Polar HP belt.

Surface winds move from this HP towards the Subpolar LP as polar easterlies.



SECONDARY AIR CIRCULATION

Secondary air circulation is the movement of air on a smaller scale, covering only a few hundred kilometres.

Winds are deflected to the left in the Southern Hemisphere and to the right in the Northern Hemisphere (Ferrel's law).

Tropical easterlies

- These winds are located at between 5° and 30°/40° N and S.
- They move from the Subtropical high pressures to the Equatorial low pressure zone.
- They migrate northward and southward as the heat equator and ITCZ move with the seasons.
- These winds gather latent heat and become warm and moist as they move over the warm tropical oceans.

Westerlies

- These winds are located at 40° - 60° N and S.
- They move from the Subtropical high pressure zones towards the Subpolar low pressure zones north and south. They move towards the poles as northwesterly winds (Southern Hemisphere) and southwesterly winds (Northern Hemisphere).

Polar easterlies

- These winds move from the poles towards 60° N and S.
- They are known as the Polar easterlies and are very cold winds.

UNIT
1

MID-LATITUDE CYCLONES

General characteristics

- ▶ Mid-latitude cyclones are also called **frontal depressions** or **extra-tropical cyclones**.
- ▶ They move from west to east. This is because they occur in the **westerly wind belt**.
- ▶ Air moves in a clockwise direction around the centre of a low pressure in the Southern Hemisphere; but moves in an anticlockwise direction in the Northern Hemisphere.
- ▶ They often occur in 'families' of 3 to 4 mid-latitude cyclones.

Areas of formation

- ▶ Mid-latitude cyclones develop at the Polar front between 40° and 60° N and S.
- ▶ The warmer westerly winds meet the cold polar easterly winds at the Polar front.

Conditions necessary for formation

- ▶ At about 50° N and S, a transition zone called the Polar front, separates the warm tropical air from the cold polar air.
- ▶ This colder air pushes in underneath the warmer air while the warmer air gets pushed up over the colder air.
- ▶ A change in the conditions at the Polar front can be caused by the jet stream, a mountain range or the shape of a coastline.
- ▶ The isobars form in a circular pattern and a cell of low pressure begins to form.



Jet stream	a narrow band of very strong, predominantly westerly air currents encircling the globe at altitudes of 10 - 15 km above the earth
Divergence	the horizontal movement of air out from a particular region
Convergence	the horizontal movement of air in towards a particular region
Front	the leading edge of an air mass; it can be warm, cold or occluded
Cold front	where a cold air mass moves against and pushes in under a warmer air mass
Warm front	where a warm air mass rises gradually up over a cold air mass
Occluded front	formed when a cold front overtakes a warm front



Stages in the formation of a mid-latitude cyclone

- ▶ The life cycle of a mid-latitude cyclone lasts from two to five days.

Initial stage

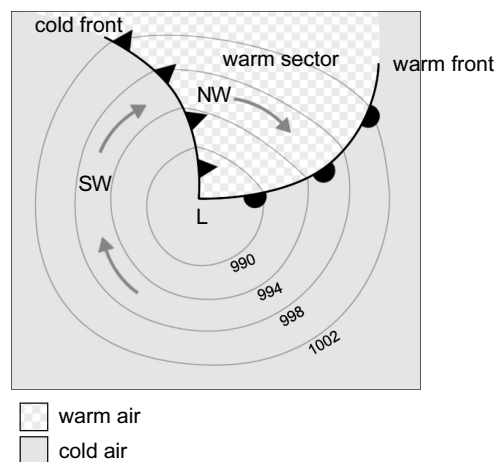
- ▶ The Polar front separates the cold Polar air from the south (polar easterlies) and the warmer subtropical air from the middle latitudes (westerlies).
- ▶ There is no movement across the line of separation between the two air masses.
- ▶ The two air masses do not mix easily because of their different characteristics: cold air is heavy and dense; warm air is light and less dense.

Development stage

- ▶ A frictional drag occurs between the cold and the warm air masses, disturbing the front.
- ▶ The warm, less dense air is pushed up by the cold, dense air. This results in a low pressure forming.

Mature stage

- ▶ The air begins to rotate in a clockwise direction around the low pressure (Southern Hemisphere).
- ▶ The cold air pushes in under the warm air ahead of it and uplift occurs. A cold front leads the cold air.
- ▶ The warm air rises up over the cooler air ahead of it and uplift occurs. A warm front leads the warm air of the warm sector.
- ▶ Both fronts are associated with uplift, cooling and possible rain.

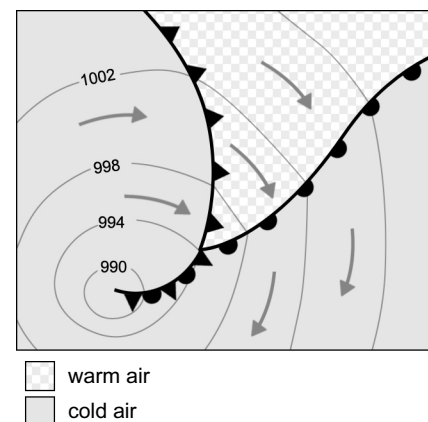


Fronts are represented by the following symbols on a synoptic weather map:



Occluded stage

- ▶ This stage is reached when all the warm air has been lifted off the surface by the colder air.
- ▶ The warm sector becomes narrower as the cold front catches up with the warm front.
- ▶ In time, the warm sector will be displaced above the cold air.
- ▶ The front is known as an occluded front.



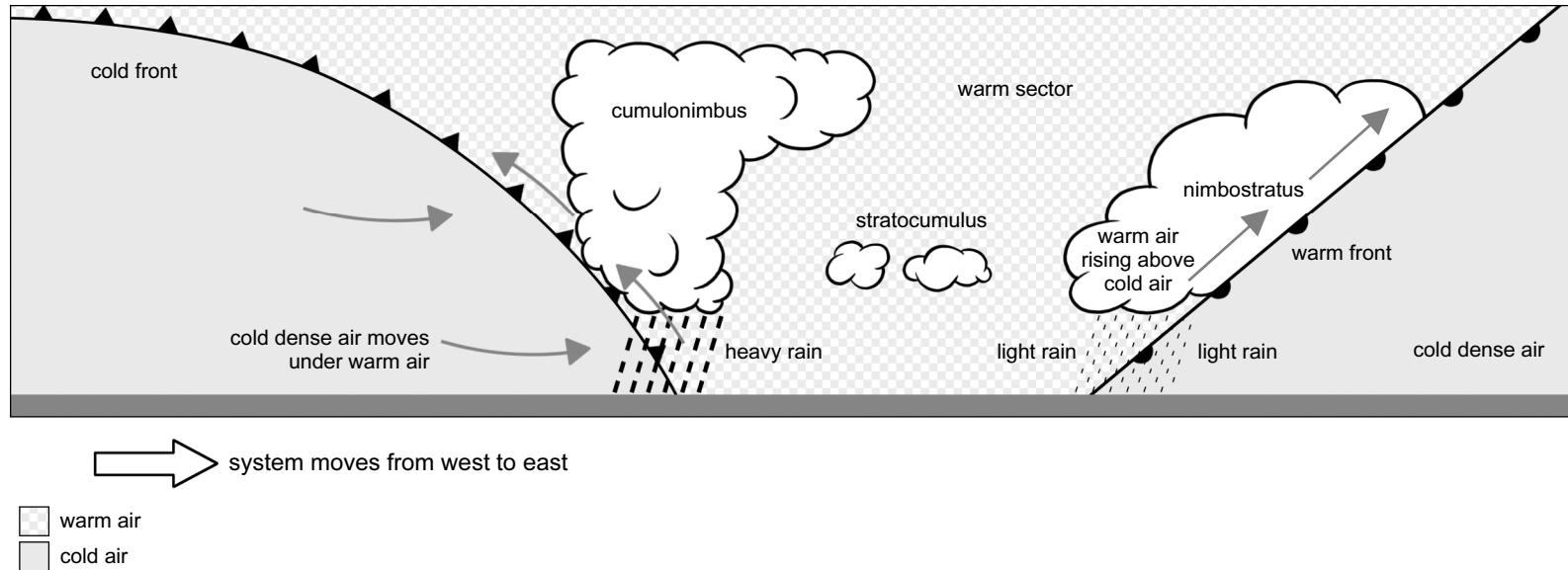
Dissipating stage

- ▶ This is the last stage of a mid-latitude cyclone – the system weakens.



Weather patterns associated with cold, warm and occluded fronts

As a mid-latitude cyclone passes over a weather station on the earth's surface, the following weather conditions can be expected:



Weather	Before and during Cold Front	Warm Sector	Warm Front
Wind direction	wind changes from west to south west (wind backs)	west	north west to west (wind backs)
Wind speed	strong winds	decreases	strong winds
Air pressure	decreases as cold front approaches then increases as cold front arrives	remains steady	decreases as warm sector arrives
Temperature	temperature decreases	warm to mild	increases as warm front passes
Relative humidity	high during precipitation	steady and high	increases as warm sector arrives
Cloud cover	cumulonimbus clouds	low stratus clouds	nimbostratus clouds
Precipitation	heavy rain or hail	clear or drizzle	soft, continuous rainfall
Visibility	poor visibility	often poor	poor but improving

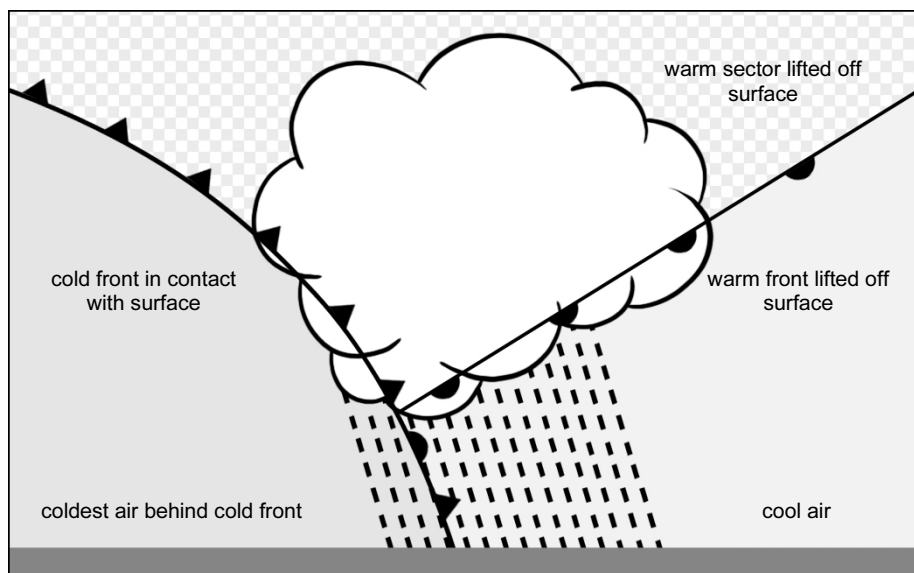


Occluded weather conditions

An occlusion takes place when the cold front catches up with the warm front. It closes the warm sector and isolates it from the earth's surface. There are cold front occlusions and warm front occlusions.

Cold front occlusion

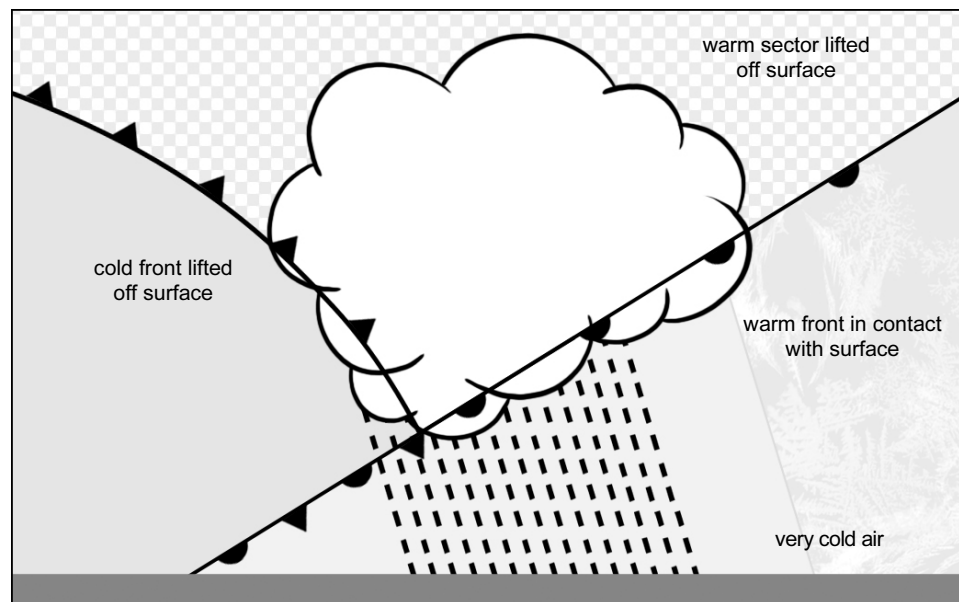
- Occurs when the coldest air in the mid-latitude cyclone is found **behind the cold front**. This causes the warm front to be uplifted along the cold front.
- As the air is forced to rise, it cools down, condensation takes place and clouds are formed.
- Rainfall occurs with conditions very similar to a cold front.



Cold front occlusion

Warm front occlusion

- Occurs when the coldest air in the mid-latitude cyclone is found **ahead of the warm front**. This causes the cold front to be uplifted along the warm front.
- As the air is forced to rise, it cools down, condensation takes place and clouds are formed.
- Rainfall occurs with weather associated with a warm front.



Warm front occlusion

1 Occluded front conditions



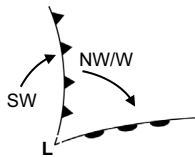
Occlusion	when a cold front catches up with the warm front, closing up the warm sector
Cold front occlusion	the air ahead of the cold front is warmer than the air behind the advancing cold front
Warm front occlusion	the air ahead of the warm front is colder than the air behind the advancing cold front

In both occlusions, the warm air in the warm sector is forced to rise. It cools, condenses and rain falls.

NOTE:



As the mid-latitude cyclone passes over an area, the wind changes direction as a result of the air circulating clockwise in the Southern Hemisphere and anticlockwise in the Northern Hemisphere.



Southern Hemisphere

The wind **backs** – wind direction shifts from northwest to southwest as the warm front, warm sector and then the cold front pass.

Cyclone Families

- ▶ Three or four mid-latitude cyclones may follow one another in a 'family' of fronts.
- ▶ In the Southern Hemisphere the oldest mid-latitude cyclone will be furthest towards the south-east.
- ▶ In the Western Cape a cold front may immediately follow another cold front, resulting in continued unsettled weather.

Impact on human activities and the environment

- ▶ Mid-latitude cyclones can sometimes bring gale-force winds, hail and thunder, cold temperatures and even snow. Storm surges may also be experienced.
- ▶ Trees are often uprooted and branches break off causing damage to building structures. Flooding may occur.
- ▶ People may be left homeless as roofs blow off houses.
- ▶ There may be extensive damage to property and disruption of infrastructure, communications and business.

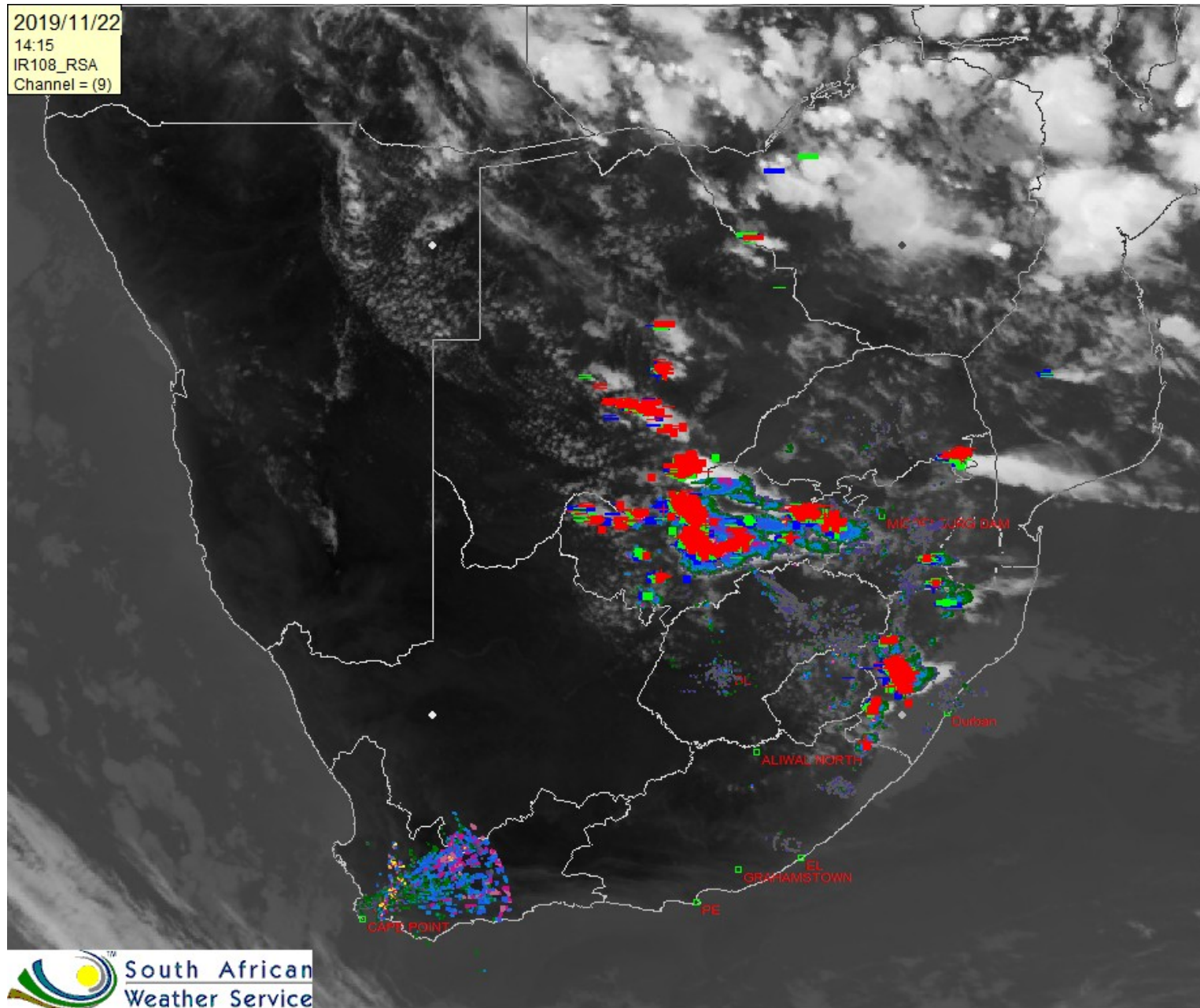
Identification and interpretation on satellite images and synoptic weather maps

Weather stations all over South Africa take weather measurements throughout the day. There are also weather stations on ships at sea and on Marion and Gough Islands. This information is then sent to the South African Weather Service.

Satellite images

- ▶ Weather satellite images are also used for interpreting and predicting the weather. Photographs taken from satellites are sent to weather stations around the world, including the South African Weather Service.
- ▶ These satellite images show detail of cloud cover and frontal systems. A cold front is identified by a band of cloud and the centre of the low pressure by a swirl of cloud. Land that is free of clouds will typically be dark in colour while clouds appear bright. Thicker clouds have a higher reflectivity and appear brighter than thinner clouds.





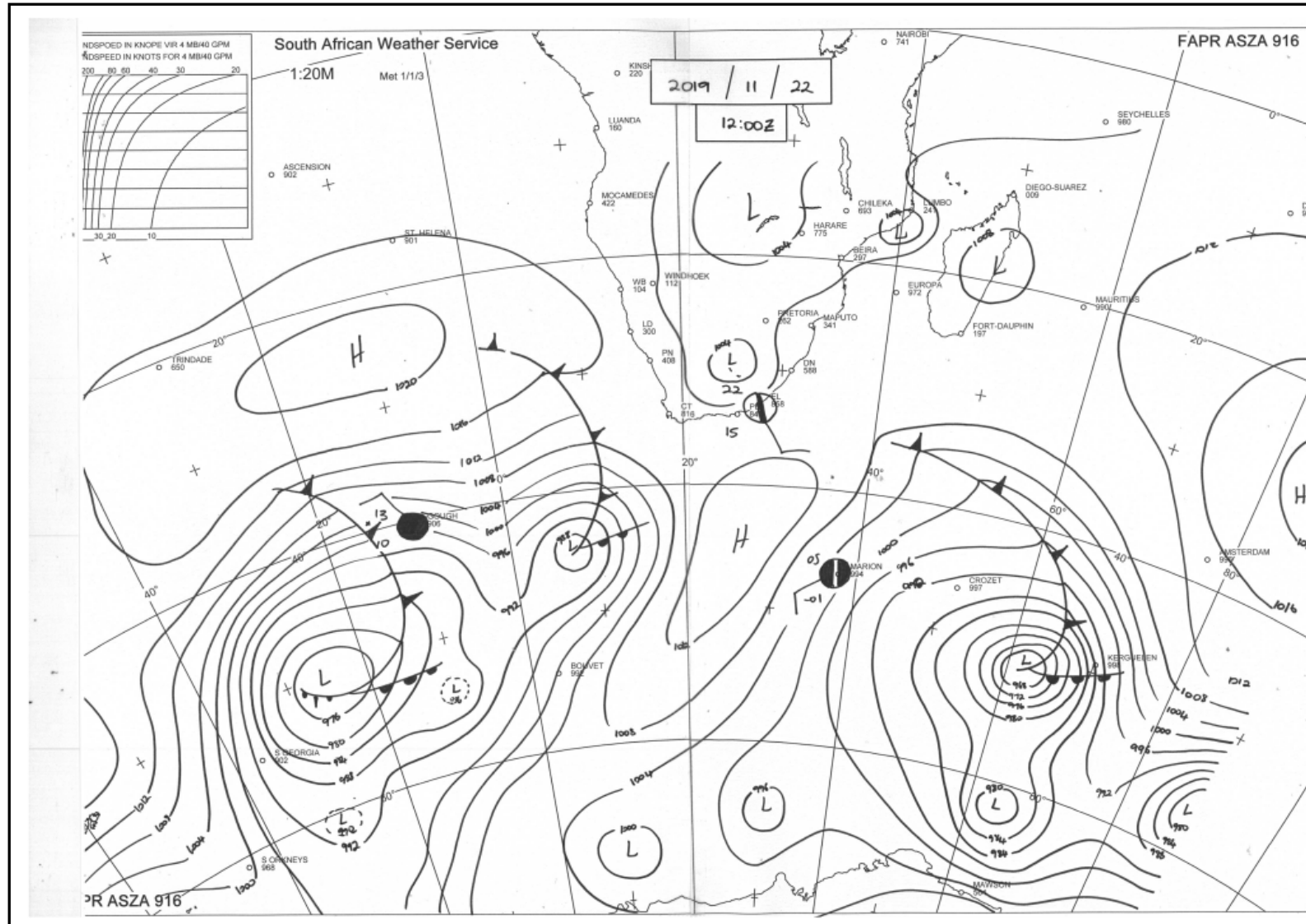
Satellite image taken at 14:15 SAST on 22/11/2019

Synoptic weather maps

A synoptic weather map shows a range of weather conditions (atmospheric pressure, temperature, precipitation, wind speed, direction, and cloud coverage) for a particular area on a particular day.

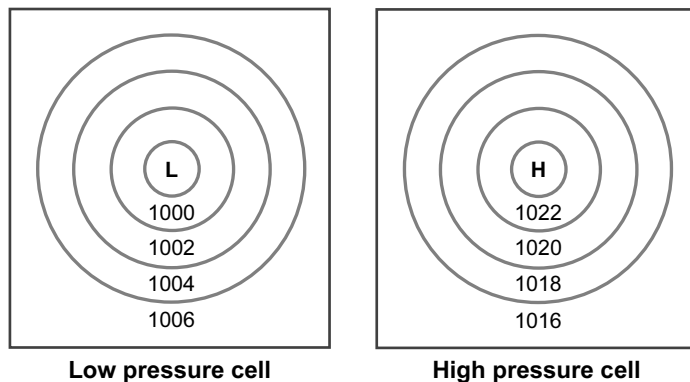


Synoptic weather maps show the actual conditions experienced at the time, not the predicted weather conditions.



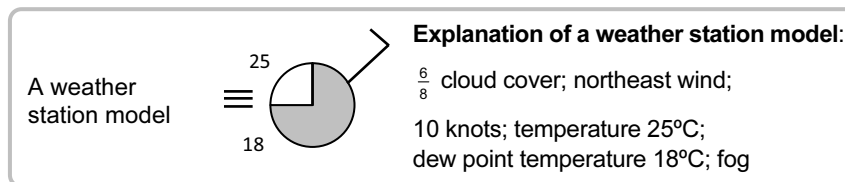
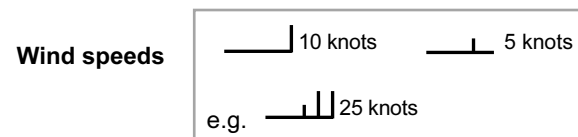
Synoptic chart reflects conditions at 12:00 on 22/11/2019

- ▶ On a synoptic weather map there are lines called **isobars**.
 - ▶ Isobars join points at equal pressure (all along one isobar the pressure is the same).
 - ▶ The pressure is measured in hectopascals (hPa).
 - ▶ The isobars form patterns, indicating low or high pressure.



At a low pressure, the pressure decreases towards the centre; at a high pressure, the pressure increases towards the centre.

- ▶ A cold front shows the leading edge of a cold air mass and a warm front shows the leading edge of a warm air mass.
- ▶ The weather of a particular place on the synoptic map is seen by referring to the **weather station**.
 - ▶ A weather station is indicated by a circle.
 - ▶ Temperature and dew point temperature are in degrees Celsius.
 - ▶ Temperature is shown as the top number; the dew point temperature is the bottom number (both in °C).
 - ▶ Precipitation (if present) is shown by a symbol between the temperatures.
 - ▶ Wind direction is shown by the 'stick' pointing in the direction **from which** the wind is blowing.
 - ▶ Each long line on the stick represents a wind speed of 10 knots. Half lines represent a wind speed of 5 knots.
 - ▶ Cloud cover is shown in eighths inside the weather station circle.

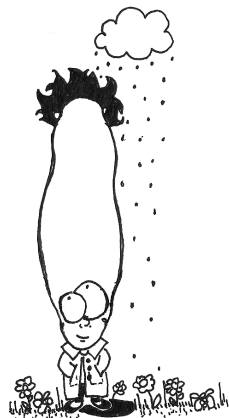


- ▶ **The features of a summer synoptic chart are:**
 - ▶ The date
 - ▶ Generally high temperatures over the land
 - ▶ Low pressure over the land
 - ▶ South Indian High Pressure found south east of South Africa
 - ▶ Tropical Cyclone
- ▶ **The features of a winter synoptic chart are:**
 - ▶ The date
 - ▶ Generally low temperatures over the land
 - ▶ Kalahari High Pressure present over the land
 - ▶ South Indian High Pressure and South Atlantic High Pressure further north and closer to the land
 - ▶ Cold fronts present

NOTE:

When interpreting a synoptic weather map, one must be able to:

1. Identify the season e.g. summer, winter.
2. Read and interpret the isobars and isobaric patterns.
3. Identify and name the three high pressure systems (South Atlantic, South Indian, Kalahari).
4. Identify the mid-latitude cyclones and associated frontal systems (cold, warm, occluded).
5. Draw a cross section of a frontal system labelling the main features.
6. Identify the air movement and the associated wind (remember a wind is named by the direction from which it blows).
7. Identify and explain the origin and effect of berg winds, coastal lows, tropical cyclones.
8. Predict the weather conditions as the frontal systems approach or move over a weather station.
9. Describe the weather conditions by analysing the information of a weather station.
10. Compare the synoptic weather map with a satellite image and identify relative frontal systems and pressure zones.

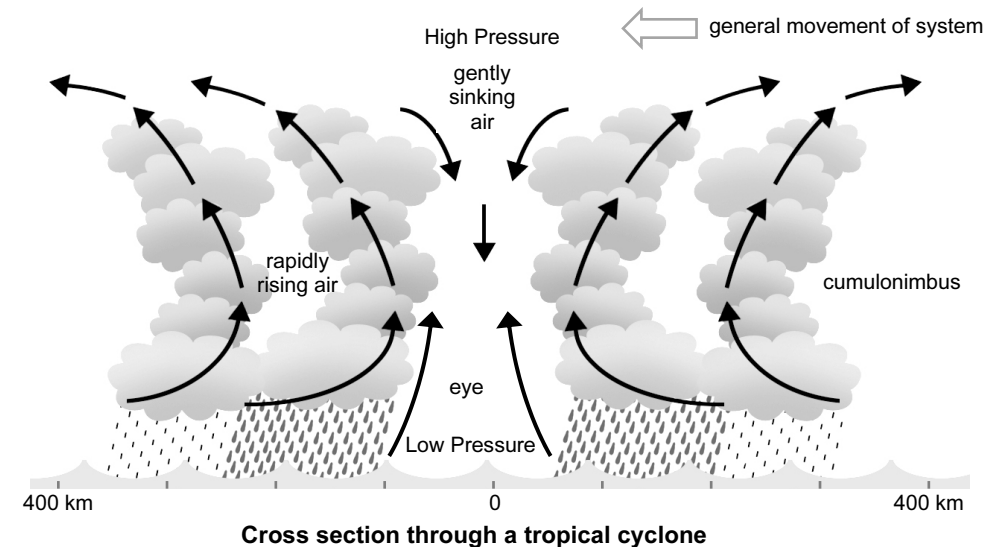


UNIT 2

TROPICAL CYCLONES

General characteristics

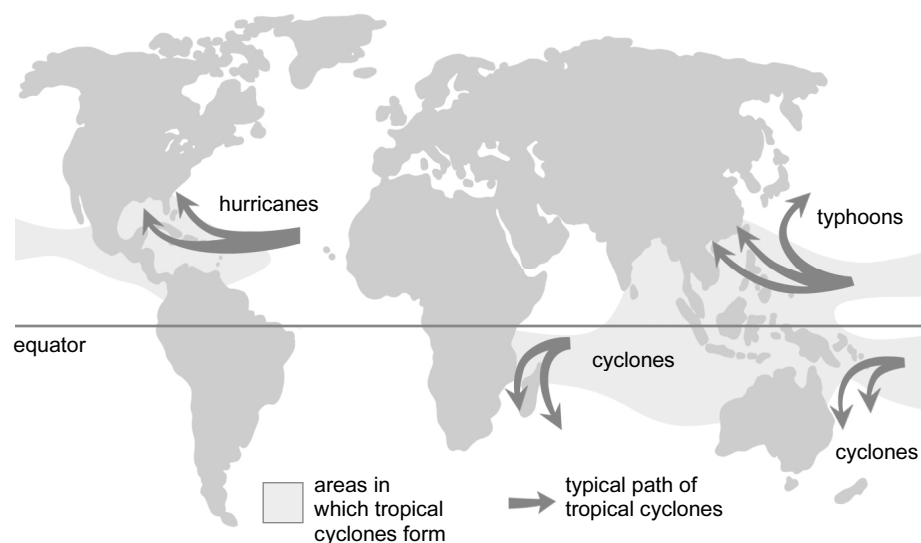
- ▶ Tropical cyclones occur from late summer to early autumn.
- ▶ They move from east to west as they form in the tropical easterly wind belt.
- ▶ They affect the east coasts of continents.
- ▶ They dissipate when they reach cooler latitudes or as they reach land (friction slows the wind and there is less moisture to provide energy).
- ▶ They are named alphabetically. The first tropical cyclone of the season starts with the letter A, followed by B, C etc., e.g. Cyclone Eline – 5th cyclone of the season.
- ▶ The centre of the tropical cyclone is called the '**eye**' and has:
 - › a calm central point
 - › light or no winds
 - › no rain
 - › very low pressure (960 hPa)
 - › a 30 - 50 km area of subsiding air
 - › high temperatures ($\pm 32^{\circ}\text{C}$)
 - › towering cumulonimbus clouds surrounding it



Areas of formation and associated terms

- ▶ Tropical cyclones occur between 5° and 30° N and S. They do not develop within 5° of the equator as Coriolis force is zero there.
- ▶ They develop over warm tropical oceans; where temperatures in the region of 27°C occur.
- ▶ Tropical cyclones usually occur on the east sides of continents because of the warm ocean currents found there.
- ▶ Tropical cyclones move from the equatorial areas towards the coast. When they reach land they turn eastwards away from the coast.
- ▶ Tropical cyclones occur in the following areas:
 - ▶ **Atlantic Ocean:** West Indies, Gulf of Mexico, south and east coasts of USA – known as **hurricanes**.
 - ▶ **Indian Ocean:** India, Madagascar, Mauritius and southern Africa (Mozambique) – known as **cyclones**.
 - ▶ **Pacific Ocean:** China Sea and Japan – known as **typhoons**.
 - ▶ **Australia** – known as **cyclones**.

Different names are given to tropical cyclones according to the region where they occur.



Distribution of tropical cyclones

Conditions necessary for formation

- ▶ **Warm oceans:** occur in late summer when sea temperatures are warm.
- ▶ **Hot air temperatures:** late summer and early autumn air rises, a low pressure develops and the rising air cools and condenses. Develop at ITCZ where hot, moist air from tropical easterlies converges.
- ▶ **Water vapour:** to condense and release latent heat to provide energy.
- ▶ **Steep pressure gradient:** so winds converge on the low pressure and begin to rotate because of Coriolis force.
- ▶ **Pressure in the centre** of the low pressure must be **below 1000 hPa**.

Stages in the formation of a tropical cyclone

Formative stage

- ▶ A low pressure cell develops.
- ▶ The atmospheric pressure is still above 1000 hPa.

Immature stage

- ▶ Pressure decreases to below 1000 hPa.
- ▶ Gale force winds develop.
- ▶ Air circulation is **clockwise** (Southern Hemisphere).

Mature stage

- ▶ Pressure is very low (e.g. 960 hPa) and pressure gradient is very strong.
- ▶ Hurricane force winds develop and heavy rain occurs.
- ▶ The worst weather is in the **forward left-hand quadrant**.

Dissipating or degenerating stage

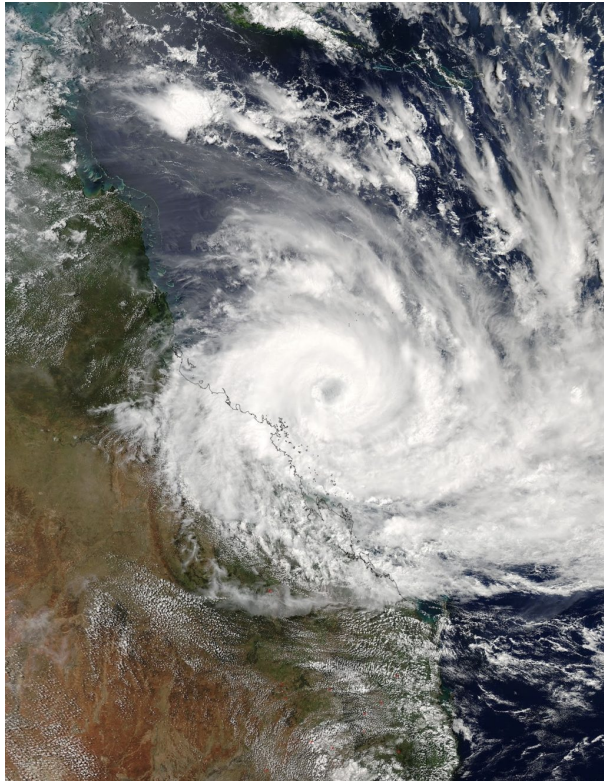
- ▶ Pressure starts to rise.
- ▶ Winds decrease in speed but heavy rain continues to fall.
- ▶ Dissipates over land or if it moves into a higher pressure area.

Associated weather patterns

- ▶ Very strong pressure gradient causes hurricane-force winds.
- ▶ Torrential rain causes intense flooding.
- ▶ Hot, humid and calm weather in the eye caused by descending warm air.
- ▶ A **storm surge** (bulge of sea water) may lead to flooding of the coastal areas. Caused by high winds pushing on the ocean's surface. The wind causes the water to pile up higher than ordinary sea level.

Satellite images and synoptic weather maps

Satellite image of a tropical cyclone (e.g. Idai)



A satellite image of cyclone Idai

Cyclone Idai

Formed	4 March 2019
Dissipated	21 March 2019
Lowest pressure	940 hPa

Tropical cyclone Idai was one of the worst tropical cyclones on record to affect Africa and the Southern Hemisphere. It caused catastrophic damage in Mozambique, Zimbabwe and Malawi, leaving more than 1 000 people dead.

Idai brought strong winds (> 195 km/h) and caused severe flooding.

A major humanitarian crisis unfolded in the wake of the cyclone, with hundreds of thousands of people in urgent need of assistance across Mozambique and Zimbabwe. A cholera outbreak followed. Infrastructural damage was estimated to be over US\$1 billion.

- ▶ The satellite image shows the tropical cyclone's extensive cloud cover.
- ▶ Note that the clouds spiral in a clockwise direction (air movement is clockwise around a low pressure in the Southern Hemisphere).
- ▶ The eye can be clearly seen as an opening in the middle of the cloud mass.

Identification on synoptic weather maps

- ▶ A tropical cyclone can be identified by:
 - a low pressure cell found between 5° and 30° N and S.
 - the date will be late summer or early autumn.
 - the symbol  will be in the middle at the eye.
 - the name of the tropical cyclone will be present.



Impact on human activities and the environment

- ▶ Tropical cyclones can cause substantial loss of life and damage to property as a result of:
 - ▶ the high sea-level and the high waves flooding into low-lying, often densely-populated coastal areas
 - ▶ strong winds along coastal areas
 - ▶ excessive flooding caused by torrential rain
 - ▶ landslides destroying crops, settlements and infrastructure
 - ▶ damage to crops, livestock, homes, infrastructure (bridges, telephone lines, electricity)
 - ▶ lack of clean water, food shortages

Pre-cautionary and management strategies to manage the effect of tropical cyclones

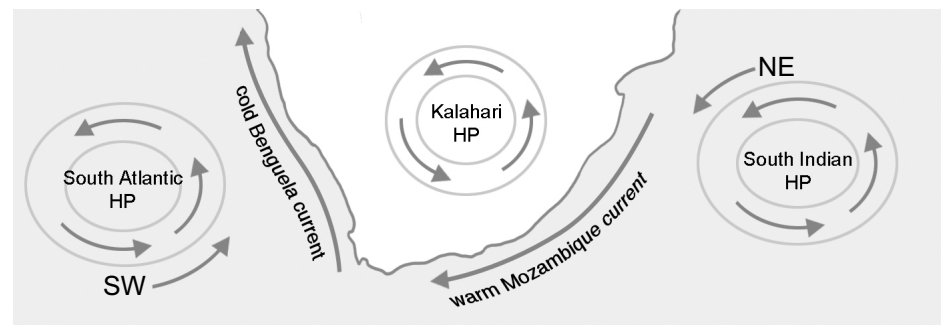
- ▶ Weather stations can identify and predict the path of tropical cyclones and so issue warnings.
- ▶ Disaster management centres have been established to manage crisis situations, such as: food, water and medical supplies and support, temporary housing, rescue operations etc.
- ▶ Prepare the community so that people know evacuation procedures and how to prepare themselves and their property.
- ▶ Land use planning: limit development in coastal areas.

UNIT 3

SUBTROPICAL ANTICYCLONES AND THE RESULTANT WEATHER OVER SOUTH AFRICA

High-pressure cells that affect South Africa

- ▶ Atmospheric circulation over southern Africa is greatly influenced by the Subtropical high pressure belt (30° S).
- ▶ This pressure belt is made up of three anticyclones:
 - ▶ **South Atlantic/St. Helena High Pressure**
Situating in the Atlantic Ocean, causes southwesterly winds to blow towards the land.
 - ▶ **South Indian/Mauritius High Pressure**
Situating east of Durban in the Indian Ocean, causes northeasterly winds to blow towards the land.
 - ▶ **Kalahari/Continental High Pressure**
Situating over the interior of South Africa.



Subtropical HP (anticyclone) cells affecting South Africa

General characteristics of the THREE high pressure cells

- ▶ High pressures, also called **anticyclones**, are associated with descending air. They result in clear skies and no rain.
- ▶ Air circulation is **anticlockwise** around anticyclones in the Southern Hemisphere.
- ▶ The anticyclones move south in the Southern Hemisphere summer and north in winter.
- ▶ During summer, these cells are weaker due to the warm surface air rising whereas in winter, the cells are stronger due to the cooler air sinking.

Influence of anticyclones on SA's weather and climate

South Atlantic High Pressure

- ▶ Causes southwesterly winds to blow towards the land off the cold Atlantic Ocean.
- ▶ Originates from subsiding air and the air circulates in an anticlockwise direction.
- ▶ It brings cool, dry, stable air to the west coast.

South Indian High Pressure

- ▶ Moves away from the coast in summer but is nearer to the coast in winter.
- ▶ The anticlockwise circulation results in northeasterly winds that bring rain to eastern South Africa.
- ▶ This is because moisture is picked up as the air moves over the warm Mozambique current.

Kalahari High Pressure

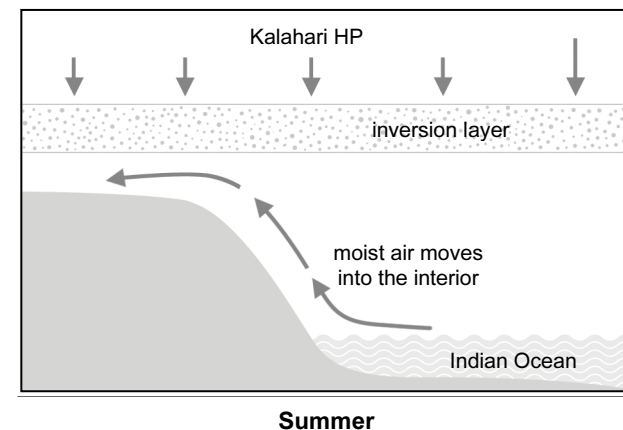
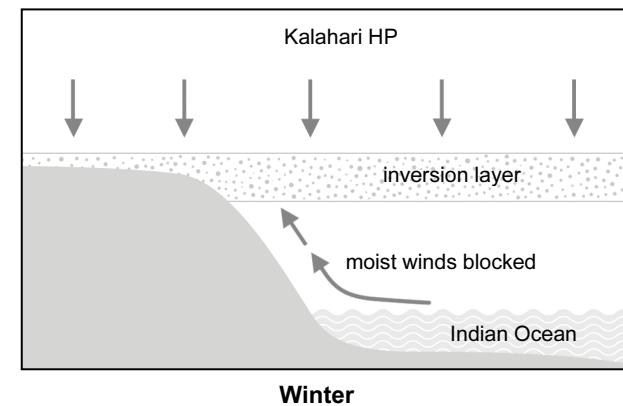
- ▶ During **winter**, the Kalahari High is the dominant pressure cell over the interior. This causes the inversion layer to sink lower than the escarpment and thus no moisture can reach the interior from the east coast.
- ▶ The result is that the interior has dry winters and mild days as the descending air is warmed **adiabatically**.



Adiabatic

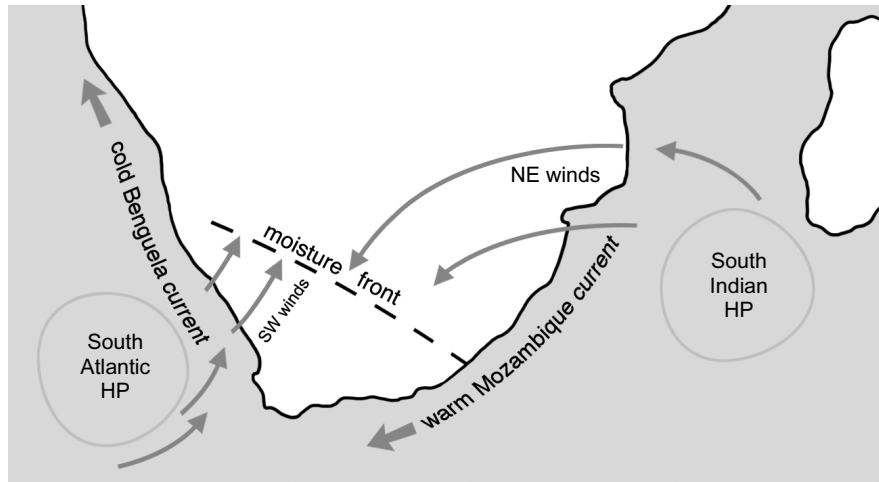
changes in the pressure and temperature of a parcel of air, when heat from outside is not added or removed; the air will either expand or contract, thus producing changes of pressure and temperature

- ▶ During **summer**, the interior warms up and air rises forming a surface low pressure cell.
- ▶ This rising air meets the descending air from the Kalahari cell at a point higher than the top of the escarpment.
- ▶ The point where the two cells meet, is called the **inversion layer**.
- ▶ Because the inversion layer is higher than the escarpment, moist air from the east coast (South Indian High Pressure) can be fed into the interior where it brings rain.



Development of travelling disturbances associated with anticyclonic circulation

Moisture front and Line thunderstorms



The moisture front and formation of line thunderstorms

- ▶ A moisture front is formed at the convergence zone of air masses from the Atlantic and the Indian Ocean.
- ▶ The South Atlantic High Pressure brings in SW winds from the Atlantic Ocean. This air is cold and does not hold much moisture. The Atlantic Ocean (Benguela current) is cold and so feeds cold, dry air onto the land from the west.
- ▶ The South Indian High Pressure brings in NE winds from the Indian Ocean. This air is warm and moist. The Indian Ocean (Mozambique current) is warm, so warm moist air is fed onto the land from the east.
- ▶ The cold, dense Atlantic air (SW) moves in underneath the warm, moist Indian air (NE), forcing it upwards. This results in a moisture front and causes condensation and convection clouds to develop.
- ▶ The moisture front brings a **line of thunderstorms** and heavy rainfall over the central parts of South Africa. Also called a 'storm line'.



NB: Cold air cannot hold much moisture.



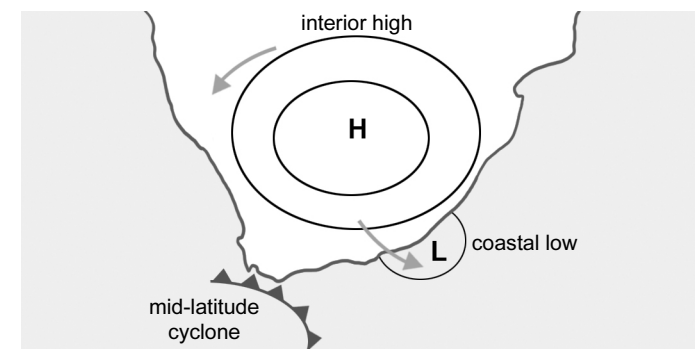
NB: Warm air can hold more moisture.

Coastal Low Pressure system

- ▶ Coastal low pressures develop over the coast of Namibia and move around the coast.
- ▶ The circulation is clockwise and this causes onshore winds on the one side and off-shore winds on the other side.

South African berg wind

- ▶ A berg (mountain) wind usually occurs during winter.
- ▶ It is a hot, dry wind and is followed by a cold front and cold, wet weather.
- ▶ **Formation of a berg wind:**
 - ▶ High pressure over the interior; low pressure on the coast.
 - ▶ Cold front approaches the land and sets up a pressure gradient between the interior high and coastal low pressure.
 - ▶ This causes warm air to move from the interior towards the coastal area.
 - ▶ As these winds blow down from the plateau/mountains to the coast, they heat up adiabatically and bring warm, dry conditions.
 - ▶ Berg winds usually occur along the east coast and move along the coast towards KwaZulu-Natal.
- ▶ Berg winds bring warm, dry conditions and consequently a threat of veld fires.



Berg wind

UNIT
4

MICROCLIMATES

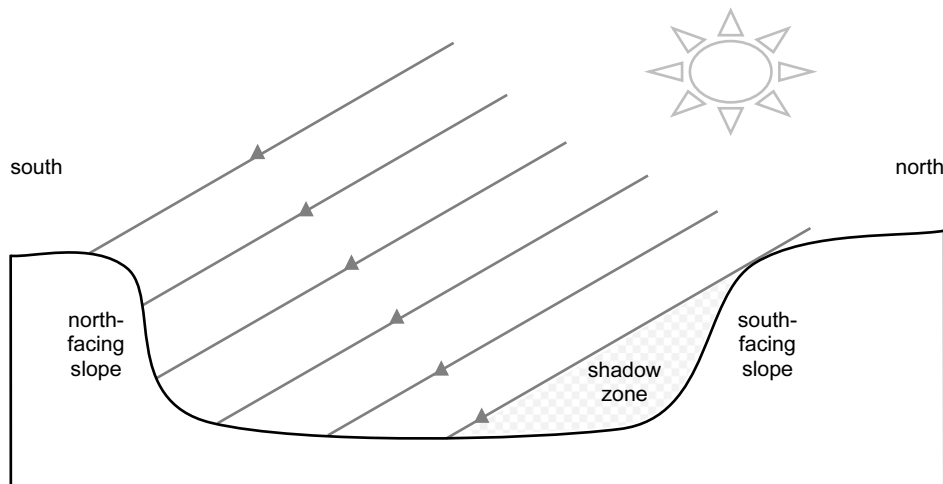
VALLEY CLIMATES

Slope aspect

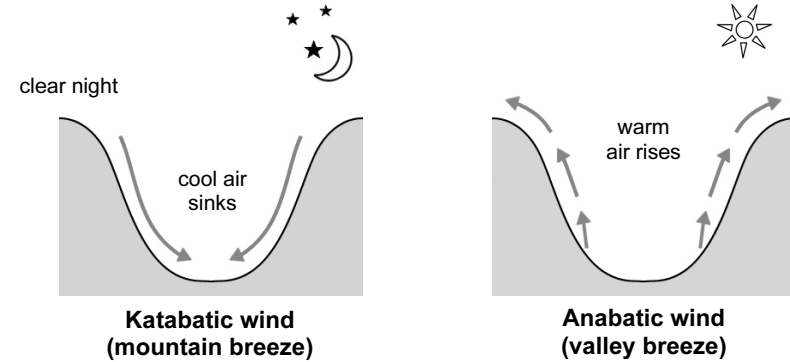
Microclimate	the weather conditions within a small local area such as a valley or an urban settlement
Slope aspect	angle at which the rays of the sun strike a slope
Shadow zone	an area that does not receive any direct sunlight



- ▶ In the Southern Hemisphere, the slopes that face north are warmer as the sun's rays are more direct.
- ▶ South-facing slopes are cooler, as the sun's rays strike them at an oblique angle.



Katabatic and Anabatic winds



▶ Katabatic winds

- ▶ Occur at night.
- ▶ Valley slopes cool down as a result of terrestrial radiation.
- ▶ The air in contact with the slope cools down and the dense, cool air sinks down the valley slopes.
- ▶ These winds are also called **mountain breezes**, e.g. the Mistral in the Alps, Switzerland and the Bora along the Adriatic Coast (east coast of Italy).

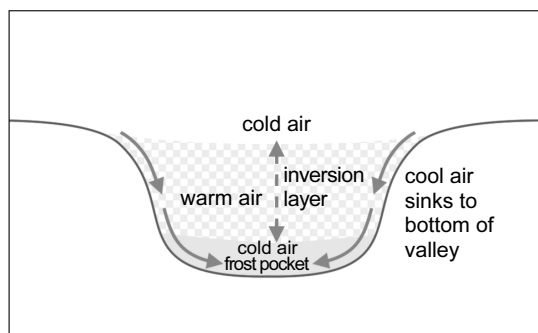
▶ Anabatic winds

- ▶ Occur during the day.
- ▶ Mountain slopes are heated and the warm air rises up the valley slopes.
- ▶ These winds are also called **valley breezes**.



Temperature inversions

- ▶ A temperature inversion is an atmospheric condition where temperature increases with height. The warmer air lies above the cooler air.
- ▶ Occurs on clear, still winter nights.
- ▶ Air resting on the surface of upper slopes cools down and becomes more dense and sinks.
- ▶ Cool air moves down the slope and collects on the valley floor.
- ▶ Results in a warmer air layer above a cold air layer: a temperature inversion.



Temperature inversion

Thermal belts

- ▶ A thermal belt is a zone on the side of a valley where night-time temperatures remain relatively mild. Temperatures above and below the thermal belt are much colder. There is little frost damage in this zone.

Frost pockets

- ▶ Frost pockets are found where cold air collects on the valley floor.
- ▶ In the early morning, if the dew point temperature is below 0°C; water vapour condenses directly into ice crystals, and frost occurs.
- ▶ This lower part of the valley then becomes known as a **frost pocket**.

Radiation fog

- ▶ Radiation fog generally forms when the air near the surface cools due to terrestrial radiation.
- ▶ It occurs on cold, cloudless nights.
- ▶ In the morning, the earth's surface heats up and the fog evaporates, clearing the valley of fog.

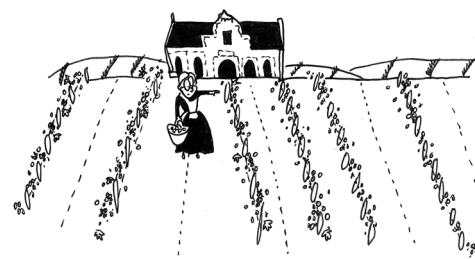
Influence on human activities

Settlement

- ▶ In rural areas in the Southern Hemisphere, people will settle on the more temperate, middle, north-facing slopes to avoid the cold valley floor and frost pockets in winter, or the low temperatures on the higher slopes.
- ▶ In urban areas in the Southern Hemisphere, people prefer to settle on the north-facing slopes to get maximum insolation from the sun, especially in the cold winter months.

Farming

- ▶ Crops that are affected by frost are cultivated on valley slopes to avoid the frost pocket that occurs at the bottom of the valley.
- ▶ An example is in the Western Cape where the frost-resistant crops are grown on the lower valley slopes, while vineyards and other frost-sensitive deciduous fruit is grown on the warmer middle and upper slopes.



URBAN CLIMATES

Reasons for differences between rural and urban climates

Temperature differences

- ▶ Cities have higher average temperatures and a smaller difference between day and night temperatures than rural areas.
- ▶ The **reasons** are:
 - ▶ Artificial surfaces such as tar roads and concrete buildings absorb and retain heat longer than the natural surfaces of rural areas.
 - ▶ Glass and steel in cities reflect the heat.
 - ▶ There is more air pollution in cities which prevents maximum terrestrial radiation, especially at night.
 - ▶ Heat islands over cities trap heat so less radiation takes place.
 - ▶ The steep thermal gradient between cities and surrounding areas reduces air flow, so less heat is lost, enhancing a **greenhouse effect**.
 - ▶ Human activities in cities, e.g. people, machines, vehicles, air conditioners, etc., generate heat.
- ▶ **Ultraviolet radiation** is 30% lower in cities than in surrounding areas in winter.

Rainfall/precipitation differences

- ▶ Cities have more fog and rainfall than the surrounding rural areas.
- ▶ The **reasons** are:
 - ▶ A higher concentration of **hygroscopic particles** brought about by pollution results in more fog developing.
 - ▶ Less moisture in the air due to less surface water to evaporate, while runoff is higher due to artificial surfaces and drains.
 - ▶ Higher rainfall (particularly convectional rainfall) with cloud cover 5 - 10% higher over cities.



Greenhouse effect	the rise in temperature that the earth experiences because gases in the atmosphere (carbon dioxide, nitrous oxide and methane) trap energy from the sun
Ultraviolet radiation	shortwave rays that are part of the energy that comes from the sun
Hygroscopic particles	small particles such as dust or sea salt on which water vapour can condense

Wind differences

- ▶ A city has lower wind speeds because of the friction of buildings, etc., however the winds are more turbulent than in the surrounding areas.
- ▶ The **reasons** are:
 - ▶ High-rise buildings cause more turbulence.
 - ▶ Buildings channel high-speed winds and gusts occur at corners of buildings.

Pollution differences

- ▶ Cities have higher pollution levels than surrounding areas.
- ▶ The **reasons** are:
 - ▶ Trapped smoke/fog is more concentrated.
 - ▶ Gaseous pollution from cars, engines and industry cannot escape.
 - ▶ Development of heat islands.
 - ▶ Acid rain more frequent.
 - ▶ Poor visibility due to fog.
 - ▶ Greenhouse effect caused by pollution.

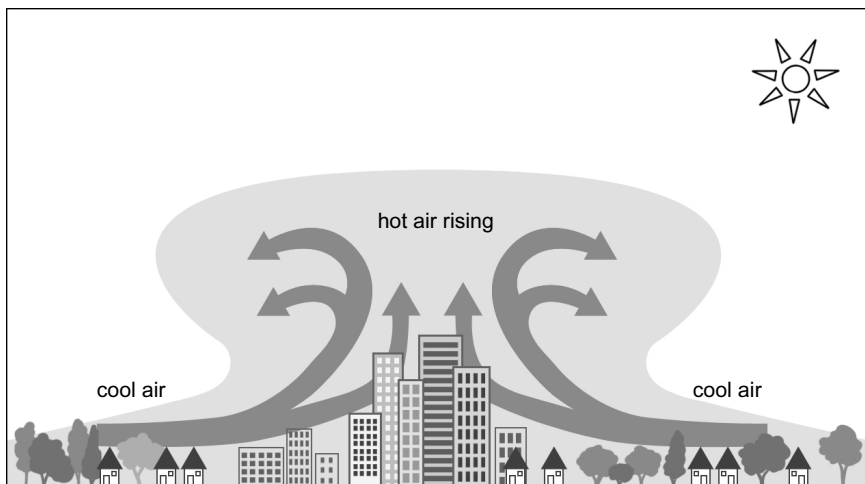


Urban heat islands

Causes and effects

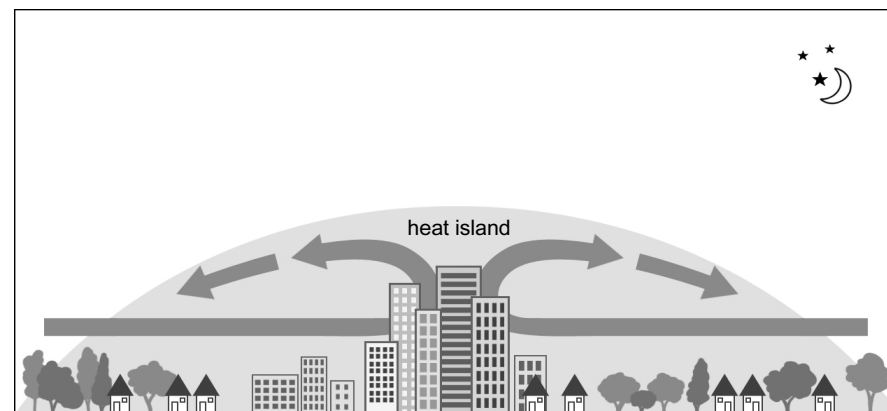
Day

- ▶ Hot air rises above a city and cool air moves in from the surrounding suburbs and rural areas.
- ▶ Warmer air over the city rises so a heat island mushrooms over the city.
- ▶ The heat island encloses the built-up area.
- ▶ The heat island is less concentrated during the day.



Night

- ▶ City surfaces lose heat more rapidly at night than the surrounding rural natural surfaces.
- ▶ The city cools at night, therefore upward-moving air currents are not so strong.
- ▶ The heat island becomes shallower and the air forms a denser layer.
- ▶ Temperature differences are not so great, making air movement in the city less strong.
- ▶ Pollution is more concentrated at night resulting in a pollution dome developing.



Strategies to reduce the heat island effect

- ▶ A number of steps can be taken to reduce the heat island effect:
 - › Increase tree and vegetation cover.
 - › Create green roofs – rooftop gardens or eco-roofs.
 - › Install cool, reflective roofs. Urban planners may also paint structures white or other light colours or use reflective materials to build houses, pavements and roads thus increasing the overall albedo of the city.



Albedo

the solar energy (shortwave radiation) reflected from the earth back into space; it is a measure of the reflectivity of the earth's surface

Pollution domes

- ▶ A pollution dome is a mass of polluted air in and above a city.
- ▶ The air is prevented from rising by the presence of an inversion above it.

Causes

- ▶ The main sources of air pollution are vehicle exhausts and the burning of fossil fuels. These gases pollute the air above a city.
- ▶ Usually pollutants would rise with the air in convection currents and then be carried away by the wind. However, if there is a temperature inversion, the pollutants are unable to rise because they are quickly cooled to the temperature of the surrounding air that is trapped under the inversion layer. This results in a pollution dome forming over a city.

Pollution plume	if there is a wind, the pollution is carried downwind to form a pollution plume
Smog	a mixture of smoke and fog (pollution particles act as hygroscopic nuclei and attract water vapour to form smog)



Effects

- ▶ Health problems – lung infections, asthma attacks.
- ▶ Acid rain – sulphur and nitrogen in the atmosphere form acid rain which destroys buildings and trees.
- ▶ Insolation is reduced as sun's rays cannot easily penetrate through pollution.
- ▶ Visibility is reduced due to smog.
- ▶ Fossil fuels increase greenhouse gas emissions (such as carbon dioxide) and contribute to climate change.

Strategies to reduce the pollution dome effect

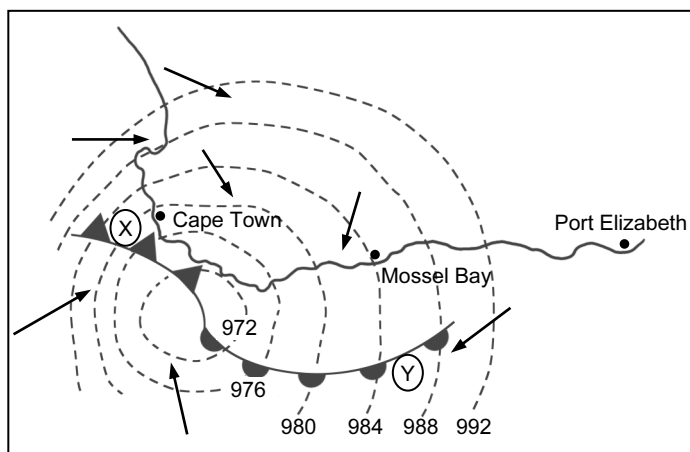
- ▶ Changing dark surfaces to light reflective surfaces.
 - Dark surfaces absorb more heat than light surfaces.
 - Lighter surfaces are cooler and produce less heat.
- ▶ Greening
 - Trees and plants shade cities from incoming solar radiation.
 - Roof gardens in the CBD help to cool the buildings and create pleasant environments for workers.



QUESTIONS CLIMATE AND WEATHER

QUESTION 1

The diagram below shows a mid-latitude cyclone.

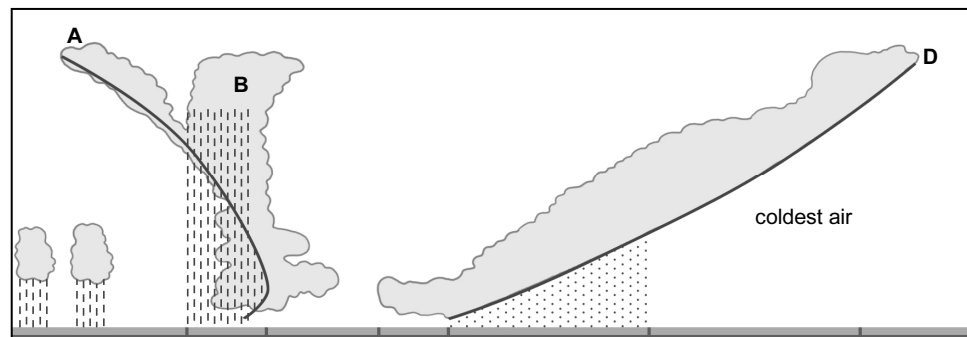


[Adapted from *Geography of Africa* by WJ Minns]

- 1.1 What evidence in the diagram shows that Cape Town is experiencing winter? (1 × 1) (1)
- 1.2 Does front X or front Y have the greater effect on the weather of Cape Town? (1 × 1) (1)
- 1.3 The weather service forecasts severe weather conditions for Cape Town. State TWO of these expected weather conditions. (2 × 2) (4)
- 1.4 Explain how the severe weather conditions will affect people living in informal settlements in Cape Town. (2 × 2) (4)
- 1.5 Explain why there will be a difference in the weather experienced at Cape Town and at Mossel Bay. (2 × 2) (4)

QUESTION 2

Study the diagram below of a cross-section of a mid-latitude cyclone.



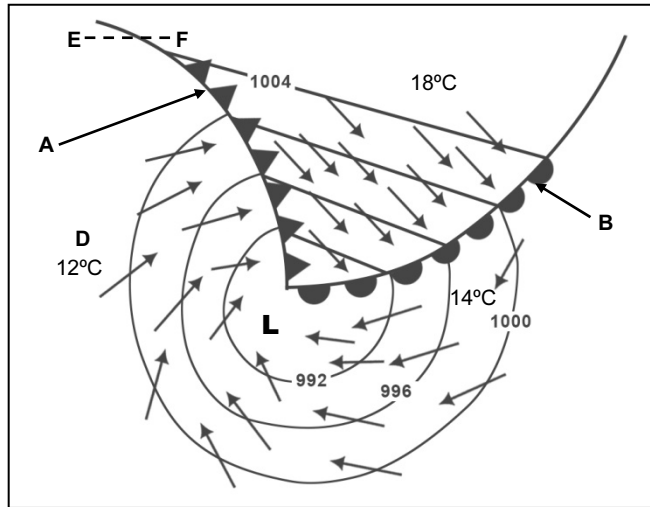
[Adapted from <http://isu.indstate.edu/ebermudez/hlth210/lessoneightc.html>]

- 2.1 Name front A. (1 × 1) (1)
- 2.2 (a) Name cloud type B. (1 × 1) (1)
(b) Account for the type of cloud at B which is associated with this weather system. (1 × 2) (2)
- 2.3 Why does the warm front (D) seldom influence the weather of South Africa? (1 × 2) (2)
- 2.4 Tabulate TWO differences between a mid-latitude cyclone and a tropical cyclone regarding place of origin and the major wind belt steering it. (2 × 2) (4)
- 2.5 Explain why the next stage of development of this mid-latitude cyclone will be a warm front occlusion. (2 × 2) (4)



QUESTION 3

The diagram below shows the mature (warm sector) stage of development of a mid-latitude cyclone.



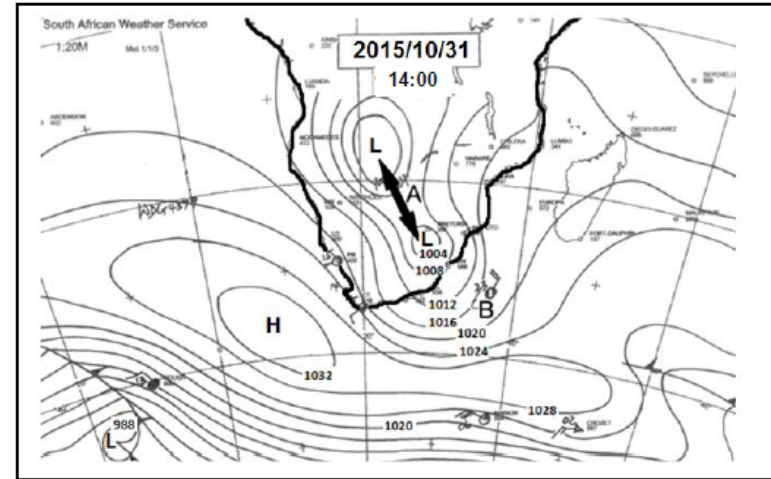
[Source: http://2.bp.blogspot.com/_LJZ5ArmANJQ/TTKJznLzb8I/AAAAAAABfk/01Qxc62l6mQ/s1600/shem]

- 3.1 Give another name for this weather system. (1 × 1) (1)
- 3.2 Give reasons for the low air temperature at D. (2 × 1) (2)
- 3.3 Draw a cross section of front A from point E to point F. Clearly indicate the main cloud type and air movements. (4 × 1) (4)
- 3.4 Give the latitudes in degrees between which mid-latitude cyclones develop. (1 × 2) (2)
- 3.5 Give evidence to support the statement that this mid-latitude cyclone is in the mature (warm sector) stage of development. (1 × 2) (2)
- 3.6 Explain how the South Indian high-pressure cell will affect the movement of the mid-latitude cyclone. (2 × 2) (4)

QUESTION 4

Refer to the synoptic weather map of southern Africa below.

Choose the correct word(s) from those given in brackets. Write only the word(s) next to the question number (4.1 - 4.7).



[Source: South African Weather Service]

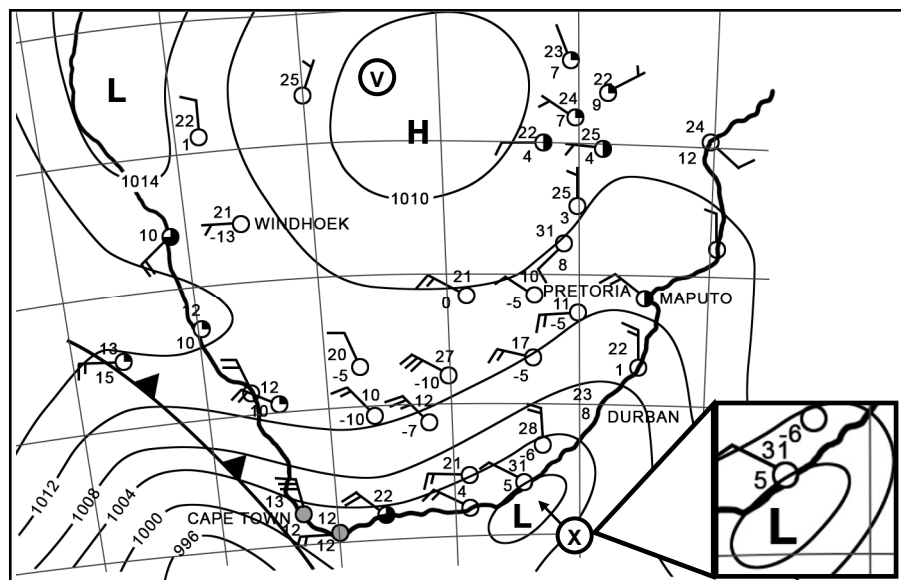
- 4.1 The synoptic weather map data was captured at (12:00/14:00).
- 4.2 The season represented by this synoptic weather map is (summer/winter).
- 4.3 Area A on the synoptic weather map is a (ridge/trough).
- 4.4 The weather system associated with the area at A creates (stable/unstable) weather conditions.
- 4.5 The wind at weather station B is a (NNE/SSW) wind.
- 4.6 The wind speed at weather station B is (20/10) knots.
- 4.7 The air pressure at the centre of the South Atlantic anticyclone is (lower/higher) than 1032 hPa (or millibars (mb)).



(7 × 1 = 7)

QUESTION 5

Refer to the synoptic weather map below.

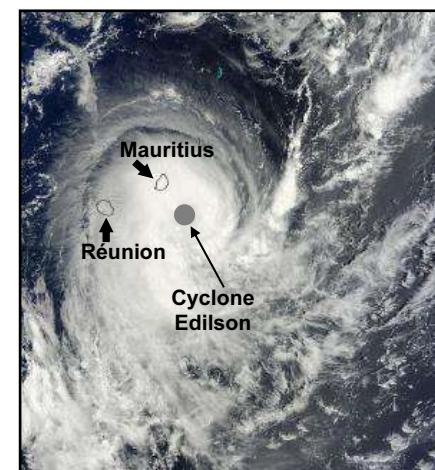


[Adapted from material from the SAWS]

- 5.1 Identify high pressure system **V**. (1 × 1) (1)
- 5.2 Identify the low pressure system at weather station **X**. (1 × 1) (1)
- 5.3 Refer to the high pressure system at **V**.
 - (a) Give ONE reason for its existence. (1 × 2) (2)
 - (b) How does this high pressure system influence weather conditions over the interior during the winter months? (2 × 2) (4)
- 5.4 Refer to the low pressure system at weather station **X**.
 - (a) Give a reason for the wind direction at **X**. (1 × 2) (2)
 - (b) Explain the high temperature experienced at weather station **X**. (2 × 2) (4)

QUESTION 6

Use the satellite image of a tropical storm below, and answer the questions that follow.

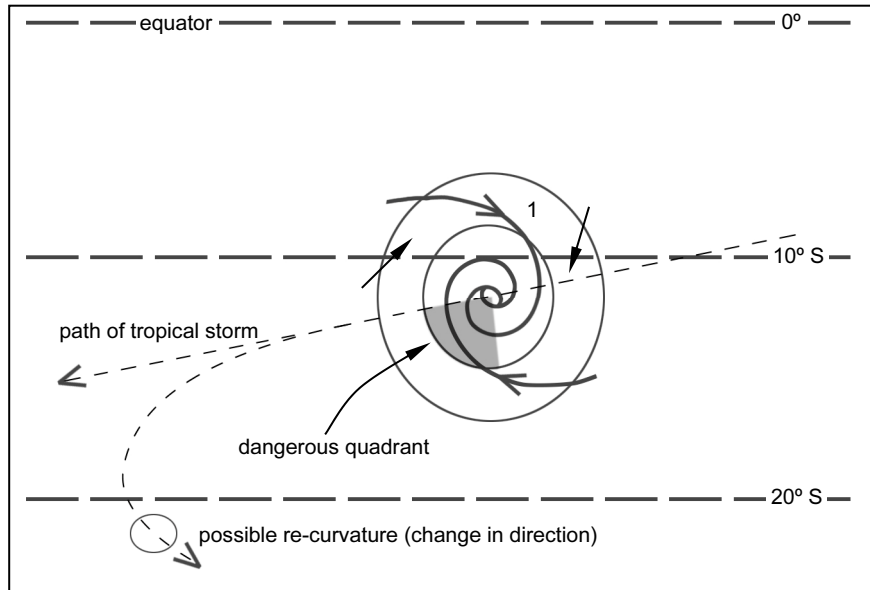


[Adapted from <http://www.weatherphotos.co.za>]

- 6.1 Identify the type of cyclone represented in the satellite image.
- 6.2 Is this a high- or low-pressure system?
- 6.3 In which season does this weather system occur?
- 6.4 Name the prevailing winds that drive this cyclone.
- 6.5 Name the global air circulation cell in which this system occurs.
- 6.6 Which ONE, Réunion or Mauritius, will experience less severe weather?
- 6.7 What does the name Edilson reveal about the number of cyclones experienced in this season?
- 6.8 Name the cloud that is found around the eye of this cyclone. (8 × 1) (8)

QUESTION 7

Refer to the diagram below showing the path of a tropical cyclone.

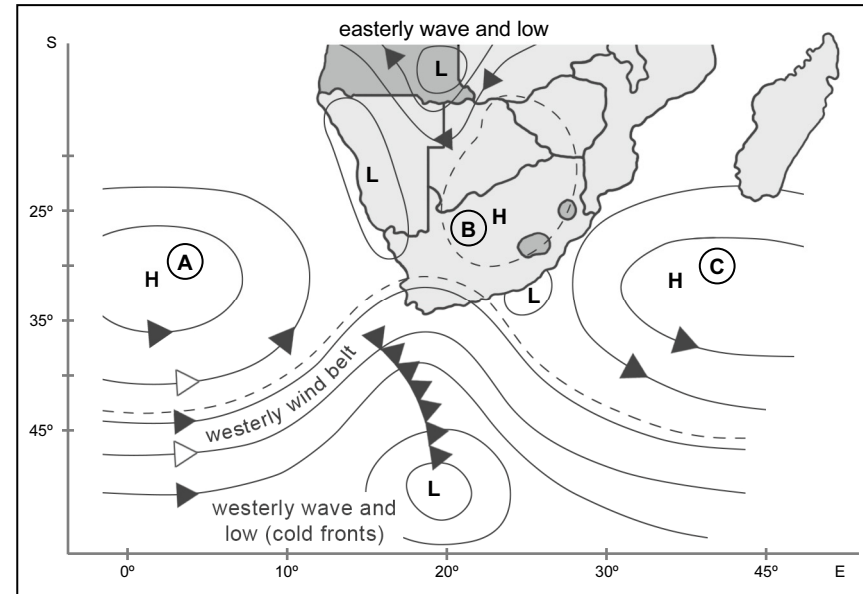


[Source: <http://about.metservice.com/assets/Learning-Centre/Mariners-Met-Pack-South-West-Pacific-ch5-Tropical-Cyclones.pdf>]

- 7.1 In which general direction do tropical cyclones move? (1 × 1) (1)
- 7.2 What evidence suggests that this tropical cyclone is found in the Southern Hemisphere? (2 × 1) (2)
- 7.3 What causes the dangerous quadrant/semicircle to form? (1 × 2) (2)
- 7.4 Give ONE reason for the possible re-curvature (change of direction) of the tropical cyclone. (1 × 2) (2)
- 7.5 In a paragraph of approximately EIGHT lines, outline the associated weather with the dangerous quadrant/semicircle and its likely impact on coastal areas. (4 × 2) (8)

QUESTION 8

Refer to the diagram below showing anticyclones over southern Africa.

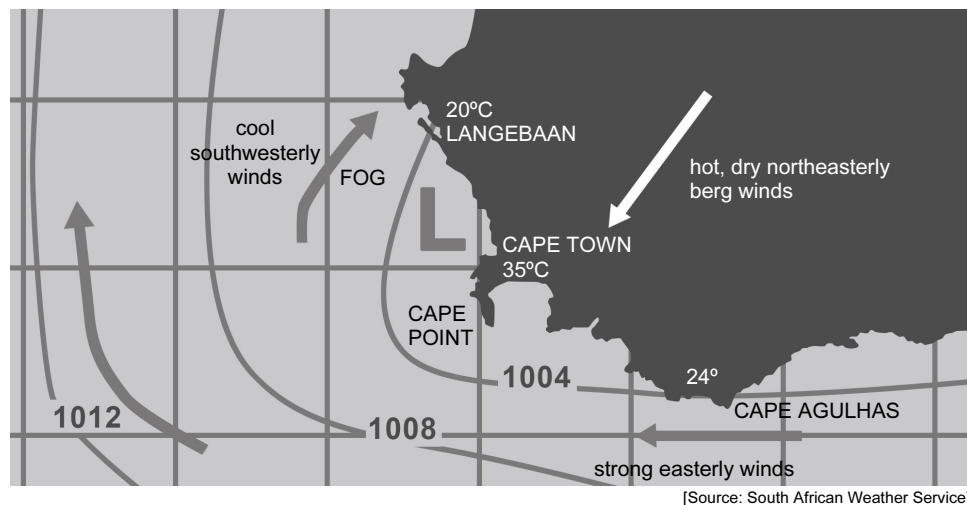


[Adapted from: <http://icesjms.oxfordjournals.org/content/62/1/33/F1.large.jpg>]

- 8.1 Name high pressure cell **B**. (1 × 1) (1)
- 8.2 Why does high pressure cell **B** dominate the interior of South Africa in winter? (1 × 2) (2)
- 8.3 Give a reason for the lack of rainfall associated with high pressure cell **A**. (1 × 2) (2)
- 8.4 Explain the change in the position of the anticyclones over South Africa between summer and winter. (2 × 2) (4)
- 8.5 Explain why the South Indian High Pressure Cell feeds more moist air over the interior in summer than in winter. (3 × 2) (6)

QUESTION 9

The diagram below shows a coastal low pressure cell (L) associated with travelling disturbances.

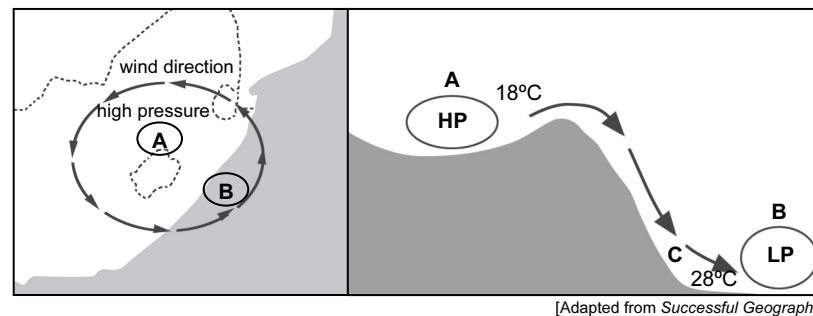


- 9.1 Use the isobars to prove that **L** is a low-pressure system.
- 9.2 Where does low-pressure cell **L** originate?
- 9.3 In which direction does low-pressure cell **L** travel between Langebaan and Cape Town?
- 9.4 What type of precipitation is associated with low-pressure cell **L** along the West Coast?
- 9.5 Name the air temperature associated with the onshore flow of low-pressure cell **L** at Langebaan.
- 9.6 How does air rotate around low-pressure cell **L**?
- 9.7 With which travelling disturbance is the hot, dry north-easterly wind associated?

(7 × 1) (7)

QUESTION 10

Refer to the diagrams below, showing a plan view and cross section of a South African berg wind.

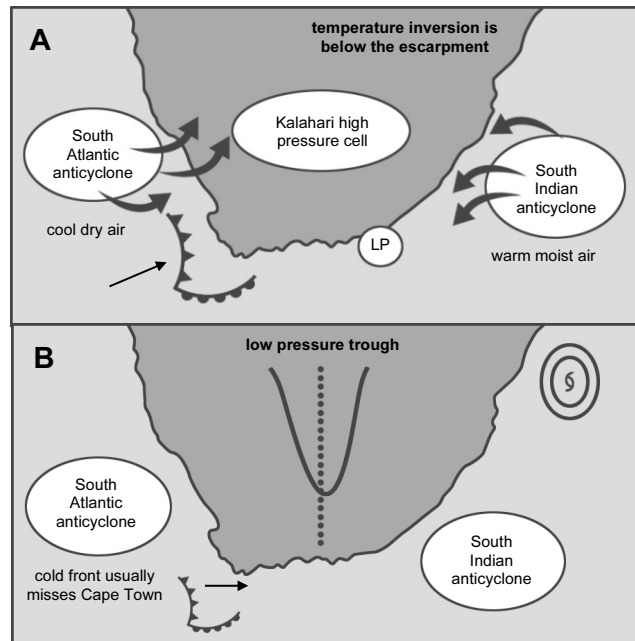


- 10.1 Give TWO pieces of evidence from the sketch to support the statement that the diagram shows a berg wind. (2 × 1) (2)
- 10.2 Why do berg winds mainly develop during winter? (2 × 1) (2)
- 10.3 Give TWO reasons for the high temperature and low humidity of a berg wind when it reaches the coast. (2 × 2) (4)
- 10.4 Explain why berg winds are viewed as having a negative influence on humans and farming. (3 × 2) (6)



QUESTION 11

Refer to the diagrams, based on inland temperature inversion below.

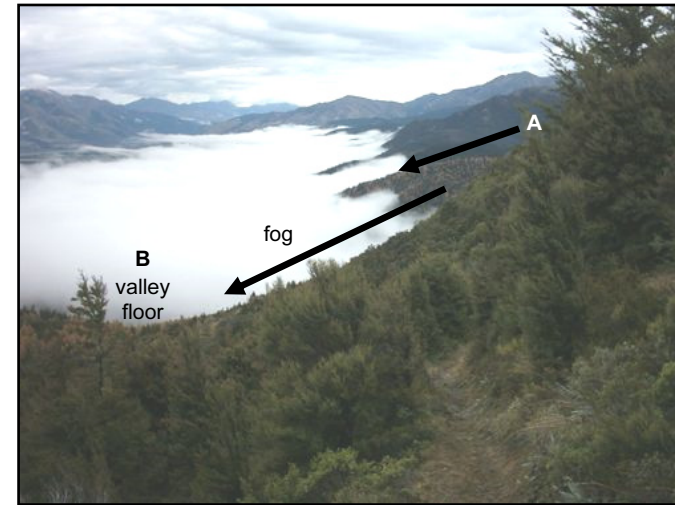


[Source: <http://slideplayer.com/slide/10180352/34/images/96/3.+High+Pressure+Systems.jpg>]

- 11.1 What is a *temperature inversion*? (1 × 1) (1)
- 11.2 Which season is represented by the position of the inversion layer in sketch **A**? (1 × 1) (1)
- 11.3 Draw a simple cross-section which will show the position of the temperature inversion in sketch **B**. (2 × 1) (2)
- 11.4 Explain why the position of the inversion layer varies between winter and summer. (2 × 2) (4)
- 11.5 In a paragraph of approximately EIGHT lines, evaluate the influence of the position of the inversion layer in sketch **A** on the climate and how it impacts negatively on economic activities in the interior of South Africa. (4 × 2) (8)

QUESTION 12

The picture below shows a katabatic wind within a valley.

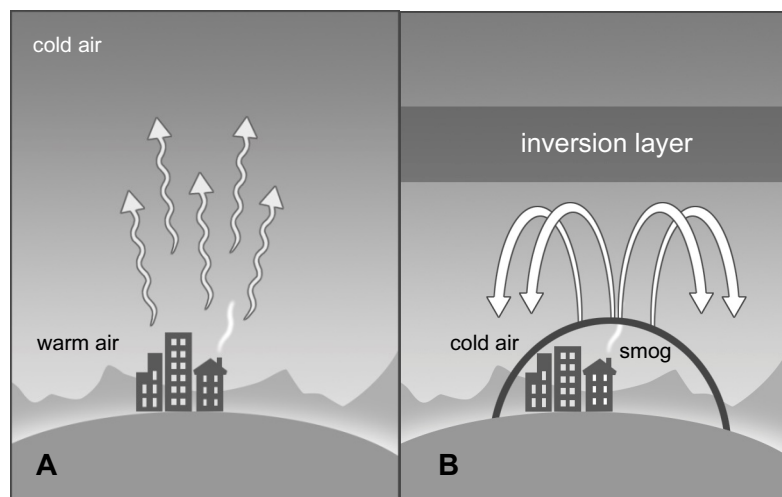


[Source: <http://fox41blogs.typepad.com/.a/6a0148c78b79ee970c019affes51c3d970c-500wi>]

- 12.1 Does this wind occur during the day or at night? (1 × 1) (1)
- 12.2 What role does terrestrial radiation play in the formation of katabatic winds? (1 × 2) (2)
- 12.3 Why are katabatic winds associated with temperature inversions? (2 × 2) (4)
- 12.4 Account for the position of radiation fog in the valley. (2 × 2) (4)
- 12.5 With reference to the photograph above, explain why a developer is more likely to build a holiday resort halfway up the valley slope. (2 × 2) (4)

QUESTION 13

The diagrams below are representations of a city's climate.



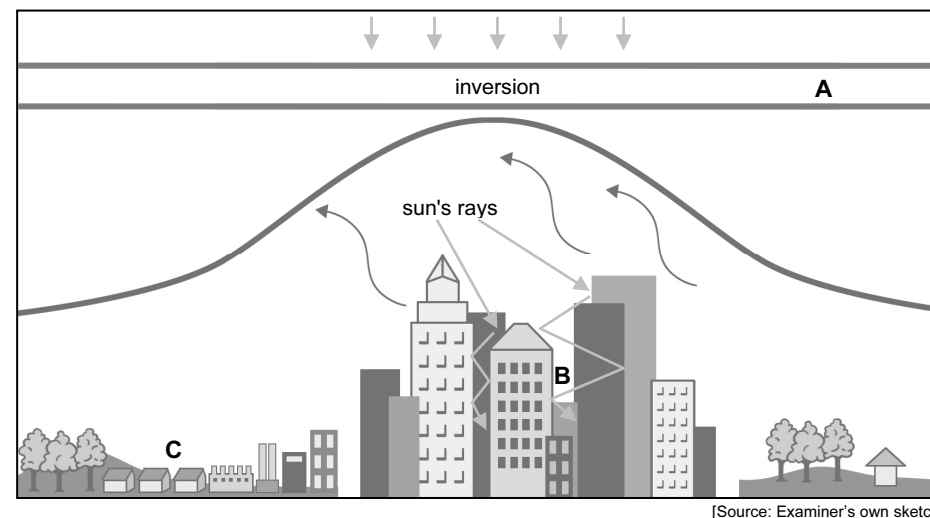
[Adapted from <http://www.buzzle.com/articles/causes-and-effects-of-temperature-inversion.html>]

- 13.1 Which sketch, **A** or **B**, represents the daytime city climate? (1 × 1) (1)
- 13.2 Give ONE reason to support your answer to Question 13.1. (1 × 2) (2)
- 13.3 Give ONE reason for the occurrence of smog in sketch **B**. (1 × 2) (2)
- 13.4 Suggest ONE reason for the absence of smog in sketch **A**. (1 × 2) (2)
- 13.5 In a paragraph of approximately EIGHT lines, discuss various sustainable solutions to limit the formation of smog in a city. (4 × 2) (8)



QUESTION 14

Refer to the diagram on city climates below. Choose the correct word(s) from those given in brackets. Write only the word(s) next to the question number (14.1 - 14.8).



[Source: Examiner's own sketch]

- 14.1 The sketch shows a (day/night) situation.
- 14.2 The inversion layer is found at a (higher/lower) altitude during the night.
- 14.3 The inversion layer (increases/decreases) pollution concentration over the city during the night.
- 14.4 The heating of the city at **B** is the result of (multiple reflections of heat/terrestrial radiation).
- 14.5 The channelling of wind between tall buildings (increases/decreases) the wind speed.
- 14.6 Temperature (increases/decreases) from **B** to **C**.
- 14.7 The influence of evapotranspiration on cooling the air will be (less/more) at **B** compared to at **C**.
- 14.8 Area **B** is associated with (more/less) cloud coverage compared to area **C**. (8 × 1) (8)

2: GEOMORPHOLOGY

UNIT 1 **DRAINAGE BASINS IN SOUTH AFRICA** 34

UNIT 2 **FLUVIAL PROCESSES** 37

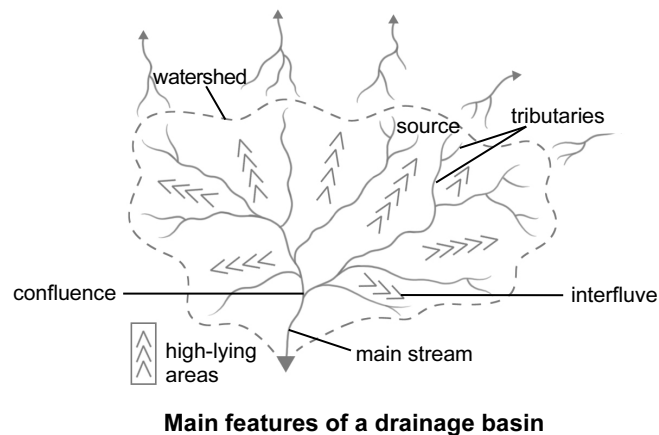
UNIT 3 **CATCHMENT AND RIVER MANAGEMENT** 43



UNIT 1

DRAINAGE BASINS IN SOUTH AFRICA

Drainage basin	area that is drained by a river system – the river and all its tributaries
Catchment area	total area that provides water to the drainage basin
River system	the main river and its tributaries and channels
Tributary	a stream that flows into the main river
Confluence	point where two rivers meet
Watershed	area of high-lying land separating two river valleys – high ridges, hills or mountains; a watershed will influence the direction of water flow and determine into which drainage basin the water will flow
Interfluve	ridge of high ground between individual river channels (also called a spur)
Source	place where a river starts
River mouth	point where the river ends, e.g. the sea or a lake
Surface runoff (overland flow)	water that flows over the ground; this sometimes happens during heavy rain or when the soil is already saturated
Groundwater	water that is found underground in the pores and cracks of a rock
Water table	the upper level of the underground water; below the water table the rock is saturated



Types of rivers

Permanent river

- ▶ A river that flows constantly throughout the year.

Periodic river

- ▶ A river that flows only during the rainy season.

Episodic river

- ▶ A river that flows only after heavy rain. It may remain dry for several years.

Exotic river

- ▶ A river that has its origin in a high rainfall area and flows through an arid region/desert.

Permanent rivers are also known as **perennial rivers**, while periodic, episodic and exotic rivers are also known as **non-perennial rivers**.

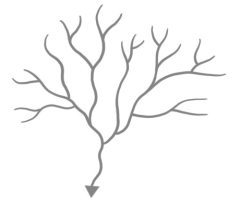


Drainage patterns

The rock structures underlying the relief of an area will determine the drainage pattern. The streams flowing over an area will create a variety of patterns on the surface.

Dendritic pattern

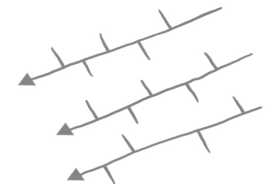
- ▶ Most common pattern with a tree-like appearance.
- ▶ Rivers flow over uniform rock layers that have uniform resistance to erosion.
- ▶ Develops where the underlying rocks are massive igneous rocks or there are horizontal layers of sedimentary rock.



Dendritic pattern

Trellis pattern

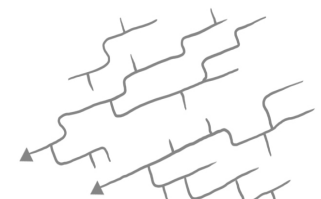
- ▶ Parallel streams with short tributaries.
- ▶ Tributaries meet the main stream at right angles.
- ▶ Found where there are folded sedimentary rocks or where there are alternating layers of hard and soft rocks.
- ▶ Parallel valleys are formed in the softer layers of rock.
- ▶ The shorter streams often erode poorts or gaps through the mountains.



Trellis pattern

Rectangular pattern

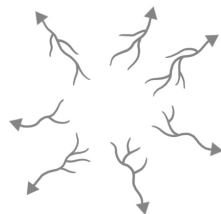
- ▶ Similar to trellis pattern, but different because rectangular pattern streams have a 90° bend in their own courses.
- ▶ This is due to the presence of intersecting fault lines and joints.
- ▶ Found in joints and faults of igneous rocks and horizontal layers of sedimentary rock.



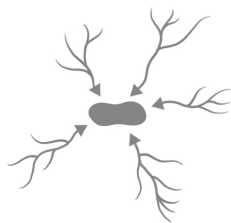
Rectangular pattern

Radial pattern

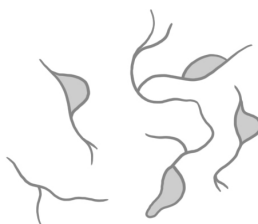
- ▶ Streams radiate outward from a central high point.
- ▶ Found mostly around buttes, domes and volcanoes.

**Radial pattern****Centripetal pattern**

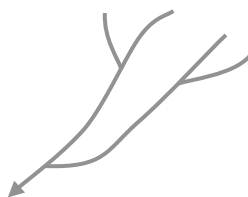
- ▶ Opposite to radial pattern, because streams flow in towards a central basin or low-lying area such as a lake.
- ▶ This system is not connected to the sea and is often found in arid regions.

**Centripetal pattern****Deranged pattern**

- ▶ Found mostly in areas of glacial erosion where surfaces have been scoured flat by glaciers leaving glacial debris.
- ▶ Characterised by small streams following irregular routes, swampy depressions and many small lakes.

**Deranged pattern****Parallel pattern**

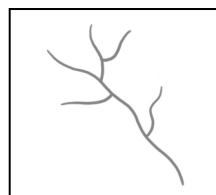
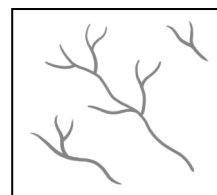
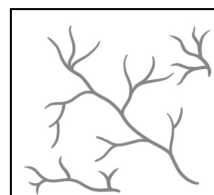
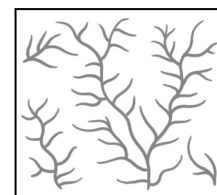
- ▶ River and its tributaries flow down slope nearly parallel to one another.
- ▶ Develops on a surface that slopes uniformly but is fairly steep. Strata have uniform resistance to erosion.

**Parallel pattern****Drainage density**

- ▶ This is the ratio between the total length of all the streams in a river system and the area of the drainage basin that it drains.

$$\text{Drainage density} = \frac{\text{total length of the streams in the basin (km)}}{\text{total area of the drainage basin (km}^2\text{)}}$$

- ▶ Drainage density is used to measure and compare drainage basins.
- ▶ Drainage density is classified as low, medium, high or very high.

**Low density****Medium density****High density****Very high density****Factors influencing drainage density****▶ Precipitation**

Areas with high rainfall usually have a high drainage density.

▶ Evaporation

High evaporation rates will reduce the amount of run-off. This causes a lower drainage density.

▶ Soil Moisture

Dry soil will soak up moisture more easily than wet (saturated) soil. Areas that are saturated will have a higher drainage density than areas that have less soil moisture.

▶ Vegetation

Forested areas intercept more rainfall than grassy areas. Dense vegetation increases surface retention and protects the soil against evaporation. These areas will have a lower drainage density.

▶ Slope/Gradient

A steep slope will promote a rapid run-off and will have a higher drainage density.

► Porosity

Soil that is porous will result in less surface run-off and will have a lower drainage density. Soil that is less porous will result in greater amounts of surface run-off as water will not be able to penetrate the soil, resulting in a higher drainage density.

► Permeability

There will be greater surface run-off if the rock is impermeable. This will result in a higher drainage density.

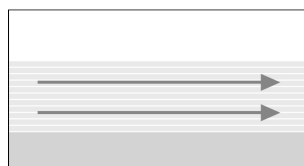
Determining stream order

- Topographical maps can be used to identify stream order and drainage density.
- Stream order is a simple ranking system used to describe river systems.
- A 1st order stream has no tributaries and has the lowest rank order.
- When two 1st order streams join, they become a 2nd order stream. When two 2nd order streams join, they become a 3rd order stream and so on.
- Only when two streams of equal order join, is a new, higher stream order created.

Discharge of a river

Laminar and turbulent flow

- **Laminar flow:** occurs when the river bed is level and smooth. The friction is low so it results in a fast-flowing river. The water flows in thin layers.
- **Turbulent flow:** occurs when the river bed is uneven. The speed of the water is fast and this results in an irregular and whirling flow. Turbulent flow causes erosion and is also effective in the transportation of sediment.



Laminar flow



Turbulent flow

UNIT 2

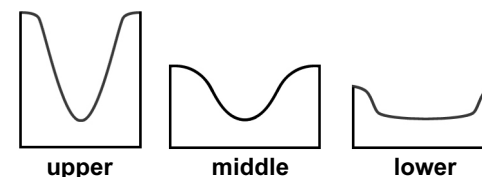
FLUVIAL PROCESSES

River profiles

- The profile of a river is determined by:
 - the **amount of energy** available for erosion (back-cutting and down-cutting);
 - the **transportation** and **deposition** of sediment;
 - the **landforms** that are shaped in this process.
- The steeper the gradient, the more rapid the stream flow, and therefore the greater the erosion process.
- Deposition takes place when the flow of the river decreases.

Transverse/cross profile

- A transverse profile is a cross section of a river from one bank/side to the other bank/side. It is also known as the **cross-profile** of the river.
- In the **young stage (upper course)**, the gradient is steep and there is more downward erosion. A deep and narrow valley is formed.
- In the **mature stage (middle course)**, the gradient is less steep and lateral erosion takes place. The valley widens with less steep river banks.
- In the **old stage (lower course)**, the gradient is very gentle and deposition takes place.



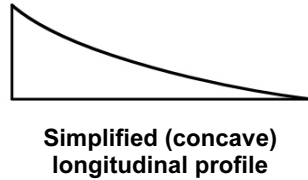
upper

middle

lower

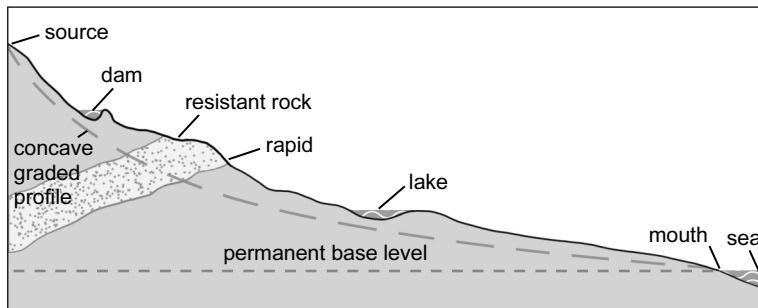
Longitudinal profile

- ▶ A profile along the length of a river from its source to its mouth.
- ▶ A longitudinal profile indicates the **gradient** of a river.
- ▶ The ideal longitudinal profile is **concave** in shape – steep in the upper course and more gradual in the lower course.



River grading

- ▶ **Graded river:** a balance has been achieved between erosion and deposition. The gradient, volume and channel shape are in equilibrium so that the river has just sufficient energy to flow.
- ▶ **Ungraded river:** when a river has many temporary bases of erosion (e.g. waterfalls, lakes) along the longitudinal profile.
- ▶ **Overgraded river:** the river erodes the channel. It has a lot of energy.
- ▶ **Undergraded river:** the river deposits some of its load. It does not have enough energy to flow and transport its load.



Temporary base levels along a river course

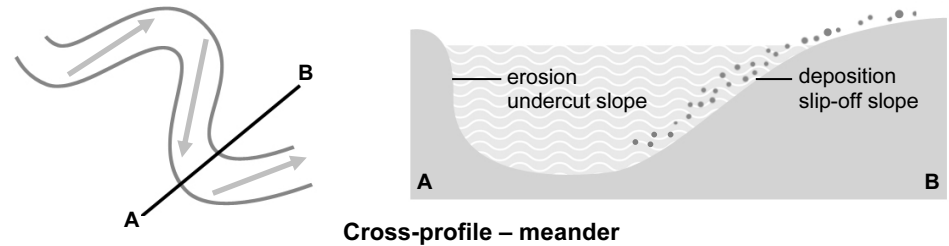
Base level of erosion	the lowest level at which a river can erode
Temporary base level of erosion	changes in gradient along a river course that cause the river to temporarily slow down; it may be caused by a hard resistant rock layer and may form a temporary barrier, e.g. dams, lakes, waterfalls and rapids
Permanent base level of erosion	the lowest level to which a river will erode the land – this is sea level



Identification and description of fluvial landforms

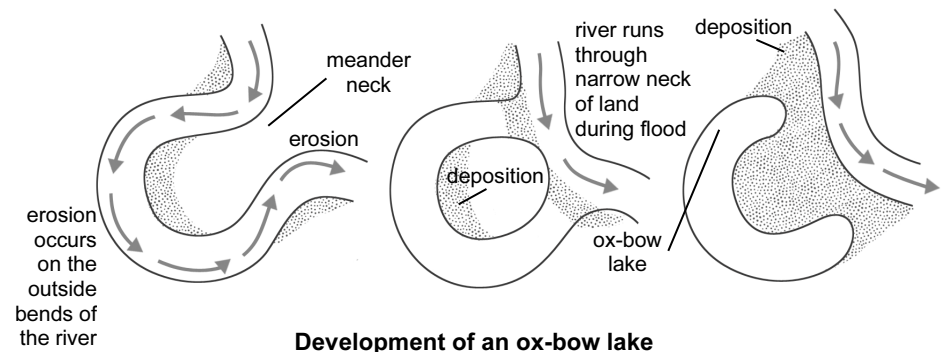
Meander

- ▶ A bend or curve in the course of a river.
- ▶ When a river flows around a bend, the flow is faster on the outer bend, so erosion occurs there forming an **undercut slope**. On the inner bend, the speed is slower so material is deposited there forming a **slip-off slope**.



Ox-bow lake

- ▶ A small lake which was originally part of a meander of a river.
- ▶ Formed when a river beaks through a meander neck.
- ▶ Sediment is deposited and the meander becomes cut off from the river to create a lake.
- ▶ When an ox-bow lake dries up, it becomes a **meander scar**.



Sand island

- ▶ A sand island is formed by deposits of alluvium in the middle of the river channel.

Braided stream

- ▶ A stream or river which splits into two or more smaller channels due to the deposition of silt. The channels rejoin further downstream.
- ▶ In some rivers there is so much deposition that the river blocks its own course. Small rivulets develop and weave their way around sand banks.

Flood plain

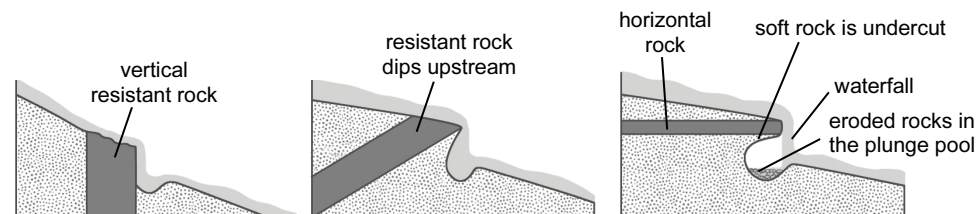
- ▶ A lowland area next to a river that has been built up by the deposition of alluvium (silt) in times of flood.

Natural levee

- ▶ When a river is in flood silt is deposited on the banks and a natural embankment is formed.
- ▶ When repeated flooding takes place, the flood plain gradually fills with silt deposits many metres deep.

Waterfall

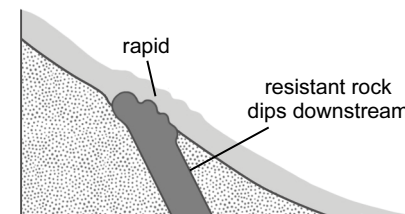
- ▶ A steep or vertical descent of the water in a river.
- ▶ Formed when a hard rock layer covers underlying soft rock layers.
- ▶ The river erodes upstream (headward erosion) undercutting the softer layers faster than the harder layers.
- ▶ When the undercut softer rock can no longer support the harder rock above, the top rock collapses.
- ▶ As the waterfall moves upstream, a **gorge** may form.



Formation of a waterfall

Rapid

- ▶ A small waterfall with turbulent water along a stretch of the river.
- ▶ Develops when a hard rock layer dips downstream.
- ▶ There is an increase in the water velocity and turbulence of the river.



Rapid

Delta

- ▶ An accumulation of silt deposited at the mouth of a river.
- ▶ A river's speed is reduced when it flows into the still waters of a sea or lake.
- ▶ Large scale deposition occurs and a delta may form under certain conditions:
 - ▶ there must be sufficient and constant supply of silt.
 - ▶ the sea or lake must be shallow.
 - ▶ there must be no strong ocean currents at the mouth.
 - ▶ there must be a minimal tidal effect.

Rejuvenation of rivers

- ▶ The energy levels of a river can change because of an added volume of water or because there is a change in gradient. A change in gradient may be caused by:
 - ▶ a drop in sea level
 - ▶ isostatic uplift (rising of the land)
- ▶ The river has renewed energy and begins eroding downwards again.
- ▶ The river is said to be **rejuvenated**.



Rejuvenation

renewal of the erosive power of a river because of a change of gradient in the river's long profile or due to an increased volume of water

Reasons for rejuvenation

- ▶ The sea level is lowered or the land is raised by isostatic uplift. This changes the base level of erosion.
- ▶ The volume of the river increases as a result of increased rainfall, river capture or increased runoff.

Features of rejuvenation

▶ Knickpoint

The point at which increased erosion begins. It creates a break in the long profile of the river. A waterfall is usually found here.

▶ Terraces

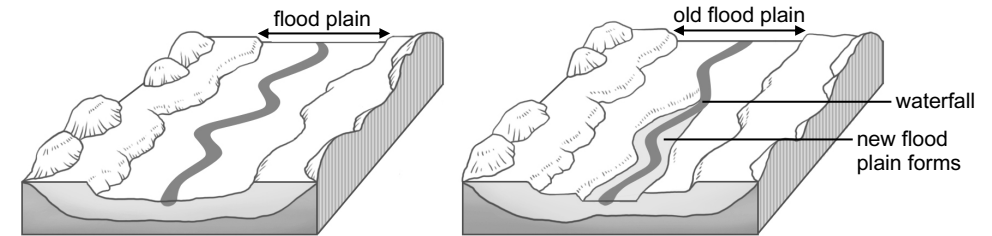
The river may cut down to a new and lower level, leaving the old flood plain abandoned at a higher level. This creates a river terrace.

▶ Valley in a valley

When rejuvenation takes place very rapidly and the base level of erosion is lowered, a valley within a valley is formed. The new valley usually has steep slopes.

▶ Incised/entrenched meanders

Increased vertical erosion takes place and the old meander is deepened and is cut down into the landscape.



River capture (stream piracy)

Abstraction

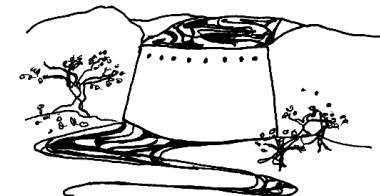
- ▶ Abstraction occurs when a watershed is altered. This happens when a watershed is cut back and lowered by very erosive rivers (**headward erosion**). It alters the position of the watershed.

Headward erosion

a river lengthens its course by cutting back upstream above its original course



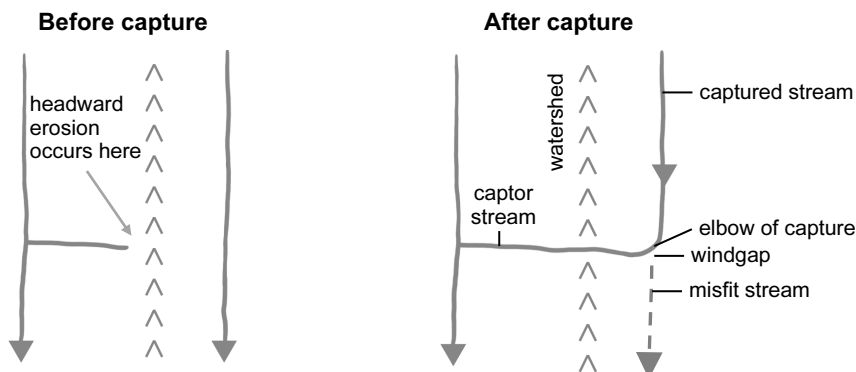
- ▶ Abstraction occurs in South Africa where the escarpment forms the main watershed. The short, fast-flowing rivers that flow down the eastern escarpment towards the Indian Ocean are very erosive and cut back towards the Orange River basin.



River capture/stream piracy

- ▶ River capture or stream piracy is the capture of a river's water supply by another river.
- ▶ River capture can occur when a river on one side of a watershed is more energetic than a river on the other side because of a:
 - ▶ **steeper gradient**
 - ▶ **larger stream volume**
- ▶ As a result it erodes by backcutting towards the watershed (headward erosion). In this way, a river cuts through the watershed and intercepts the flow of the other river.
- ▶ River capture may also occur if a river flows at a lower level and erodes through the watershed and intercepts the course of a river on a higher flow level.

Features associated with river capture



▶ Captor stream (pirate stream)

This is the capturing stream that cuts back through the watershed towards the other river. It is the more energetic river.

▶ Captured stream (captive stream)

The stream that has lost its water and has been captured. It now flows in a valley that is too big for the stream. It is the river that is diverted by the captor and is the less energetic river.

▶ Misfit stream

The stream that has lost its source waters. Also called the **beheaded river**.

▶ Elbow of capture

The bend in the river where river capture has taken place.

▶ Wind gap/river gravels

A dry river valley with river gravel. The area between the elbow of capture and the misfit river.

Impact of river capture on the captor stream and the captured stream

- ▶ After river capture, the captor stream can undergo rejuvenation and will thus have a high flow velocity and high erosion ability.
- ▶ The captor stream will also experience an increase in volume of water.
- ▶ Rejuvenation of the captor stream can result in more turbulent flow and the development of rapids and waterfalls.

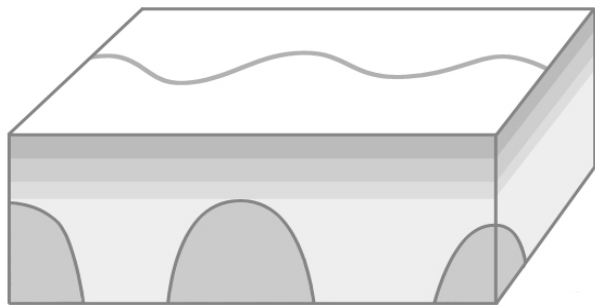
Superimposed and antecedent drainage patterns

- ▶ In some areas, stream networks display a pattern that has nothing to do with the underlying structures or relief.
- ▶ In these cases, the drainage pattern is either **superimposed** or **antecedent**.

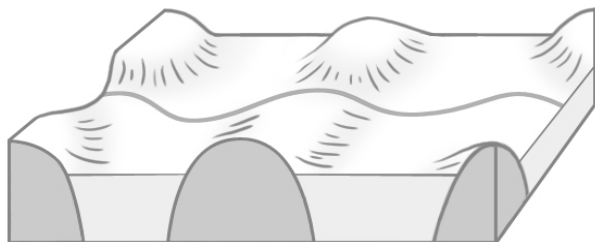


Superimposed stream

- ▶ In this drainage pattern, it looks like the river has been placed on top of the landscape.
- ▶ In such a landscape, the river eroded the original surface to reach the underlying rocks.
- ▶ Instead of altering its course due to **older rock structures**, the river kept its course.
- ▶ Therefore, through erosion the river has superimposed its current flow pattern on to the newly-exposed rock layer.
- ▶ e.g. Vaal River near Parys.



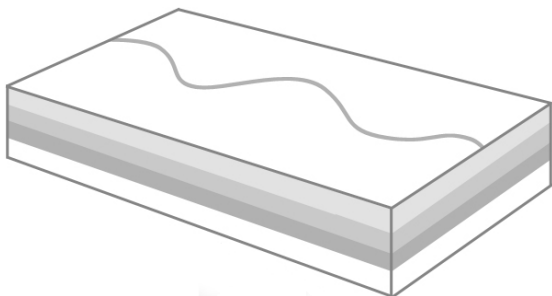
Before erosion of overlying layers



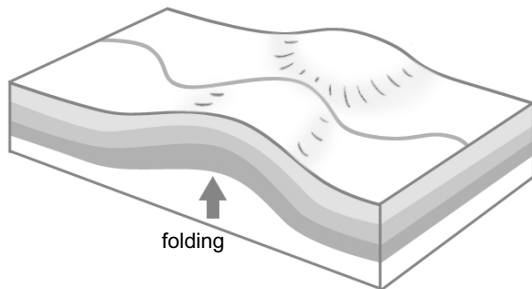
After erosion of overlying layers

Antecedent stream

- ▶ In this drainage pattern, the river developed its course over an earlier landscape that was **later uplifted** due to some form of tectonic activity.
- ▶ The river maintains its original course through the uplifted obstruction.
- ▶ This happened because the rate of down-cutting by the river was greater than the rate of uplift.
- ▶ e.g. Orange River on western escarpment before reaching the sea.



Before uplift



After uplift caused by folding

Superimposed stream	younger than the structure it flows over
Antecedent stream	older than the structure it flows over



CATCHMENT AND RIVER MANAGEMENT

There is a direct relationship and interaction between humans and the natural environment. All human socio-economic activities depend on drainage basins for the constant provision of water. However, if there is poor management of drainage basins, it puts enormous pressure on the ability to supply sufficient water for both the physical and the human environments.

Importance of managing catchment areas

► Primary water source

Rivers in a drainage basin are a primary source of water for domestic, agricultural and industrial use.

► Communication and infrastructure:

Many large rivers provide communication (shipping) and infrastructure on adjacent land. Railways and roads are more easily built in river valleys and on flood plains.

► Trade and transport

Navigable rivers form main routes for trade and transport, e.g. Mississippi (USA) and Rhine (Germany).

► Dams

Dams constructed in drainage basins store water for human consumption; generate hydro-electricity; supply water for irrigation; help with flood control; and are also used for recreational purposes.

► Boundaries

Rivers serve as boundaries between countries.

► Fertile soil for agriculture

Flood plains of large rivers contain enormous quantities of fertile soil and are therefore very important agricultural areas. In some countries the flood plains accommodate large populations and many large cities in Europe and Asia are situated on the banks of such rivers.

► Fishing

Fishing is an important activity in many rivers and lakes.

Impact of people on drainage basins and catchment areas

► River pollution

River water is polluted by industrial effluent and the disposal of hazardous waste. Run-off in agricultural areas contains high amounts of salt, nutrients and pesticides which are harmful to aquatic life and can lead to an increase in algae in the river. Mismanaged sewage works can lead to an excess of sewage going into rivers.

► Overgrazing

Overgrazing in the catchment area of a river reduces the amount of infiltration and therefore decreases the supply of groundwater flowing into the river. Overgrazing will result in an increase in the amount of water flowing over the land and so a lot of silt enters the river.

► Deforestation

Clearing of vegetation in a drainage basin decreases infiltration so there is less ground water available to feed the rivers during the dry seasons. Less vegetation results in greater run-off and more erosion and can lead to the loss of valuable top soil.

► Human settlement

Surfaces in urban areas are covered with concrete and tar. Infiltration decreases and the run-off increases. This can lead to flooding in urban areas. Buildings and recreational activities in the riparian zones disrupt the ecology and this results in various forms of pollution.



Riparian zone	area alongside a river
----------------------	------------------------

Strategies to manage drainage basins

Today, very few rivers and drainage basins in South Africa are still in their natural state – most are being changed by human activity.

Monitoring and management

- ▶ Rivers and drainage basins need to be carefully monitored and managed so that everyone can have access to water. River ecosystems need to be maintained and flooding controlled to provide sustained support for the environment.
- ▶ For economic development to take place, it is necessary to use the water from drainage basins. Such usage must be carefully managed so that river systems can remain sustainable.

Legislation

- ▶ Pollution is one of the most serious problems affecting drainage basins. Normally, the ecology of a river is capable of breaking down small amounts of waste. However, if there is a lot of pollution, the processes cannot cope. Legislation is therefore required to control what is discharged into rivers.
- ▶ Legislation is also necessary to control the use of underground water; building of new dams; and sinking of boreholes. Alien vegetation needs to be removed.

Education

- ▶ Farmers and the general public need to be educated to conserve and use water wisely.

Agreements

- ▶ Entire drainage basins need to be managed. Mismanagement of a channel upstream has an impact on the other rivers downstream. Where rivers form international boundaries, international agreements are necessary so that the water is accessible to all countries concerned.

Flood control

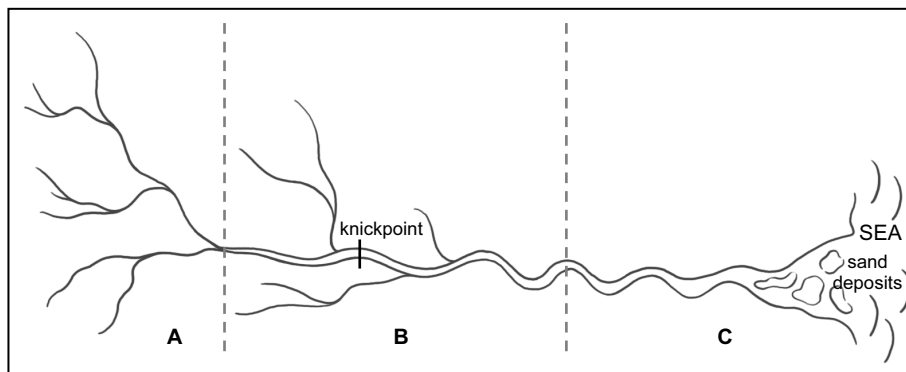
- ▶ Flooding is a natural process and can be beneficial as the silt deposits enrich soils. However, floods can cause tremendous damage to property, the environment and even loss of human life.
- ▶ Flood control is therefore a very important management strategy.
- ▶ **Flood damage** can be **minimised** in a number of ways:
 - ▶ Enlarge river channels to hold more water.
 - ▶ Build artificial banks alongside the river (artificial levées).
 - ▶ Build channels and install flood gates to lead the water away from settlements.
 - ▶ Build reservoirs to store water.
 - ▶ Prevent the building of settlements on sites where flooding is likely.
 - ▶ Protect natural vegetation.
 - ▶ Protect wetlands.



QUESTIONS GEOMORPHOLOGY

QUESTION 1

Study the diagram below based on a river system.



[Adapted from <https://za.pinterest.com/pin/430516045604913515/>]

- 1.1 Name the drainage pattern in the upper course of the river in area **A**.
- 1.2 Name the underlying rock structure likely to be found in area **A**.
- 1.3 Is area **A** the catchment area or the mouth of the river?
- 1.4 State the type of erosion that causes deep valleys in area **A**.
- 1.5 Name a natural feature that forms at a knickpoint (in area **B**).
- 1.6 In which course of the river does deposition dominate?
- 1.7 Name the landform that is likely to form from the sand deposits at the river mouth.

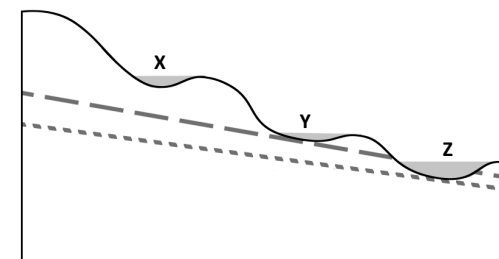
(7 × 1) (7)

QUESTION 2

Study the diagram below showing three types of rivers labelled **X**, **Y** and **Z**.

KEY

- — — — — water table during wet season
- permanent water table



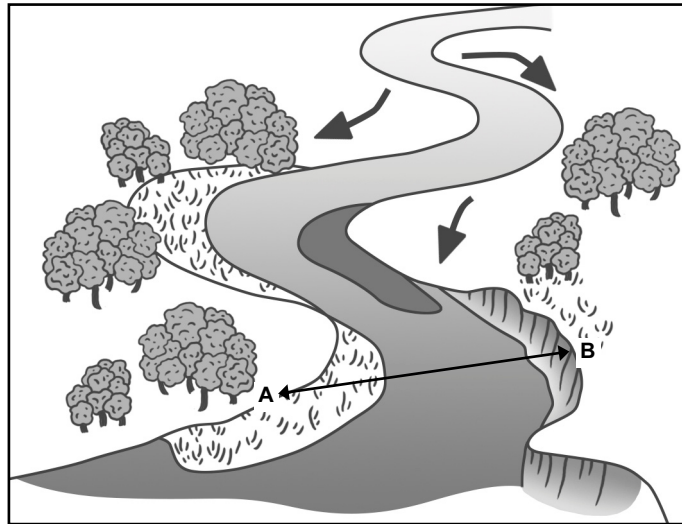
- 2.1 Which river (**X**, **Y** or **Z**) is episodic?
- 2.2 Which river (**X**, **Y** or **Z**) flows only in the rainy season?
- 2.3 Which river (**X**, **Y** or **Z**) is dependent on surface water only?
- 2.4 Which river (**X**, **Y** or **Z**) flows throughout the year?
- 2.5 Which river (**X**, **Y** or **Z**) flows only for a very short period of time?
- 2.6 Name the river (**X**, **Y** or **Z**) in which the water table intersects the channel throughout the year.
- 2.7 Which river (**X**, **Y** or **Z**) displays the biggest change in water levels between seasons?

(7 × 1) (7)



QUESTION 3

Refer to the diagram below showing a stream channel.

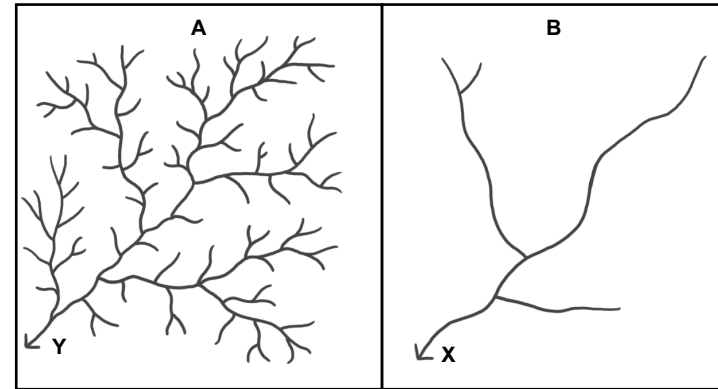


[Source: <http://adlib.eversite.co.uk/adlib/defra/content.asp?id=000IL3890W.17UT30ZOH8G447>]

- 3.1 Identify the stream channel pattern shown in the diagram. (1 × 1) (1)
- 3.2 In which course of the river is the illustrated stream channel pattern most likely to be found? (1 × 1) (1)
- 3.3 Give ONE reason why the illustrated stream channel pattern will develop in the course of the river named in Question 3.2. (1 × 2) (2)
- 3.4 Draw a simple, labelled cross-section of the meander between points **A** and **B**. (2 × 2) (4)
- 3.5 You would like to develop a campsite along the banks of the illustrated river. After careful consideration, you choose a site along slope/bank **A** rather than along slope/bank **B**. In a paragraph of approximately EIGHT lines, explain why the site along slope/bank **A** is the better choice. (4 × 2) (8)

QUESTION 4

Refer to the diagram below on drainage density.



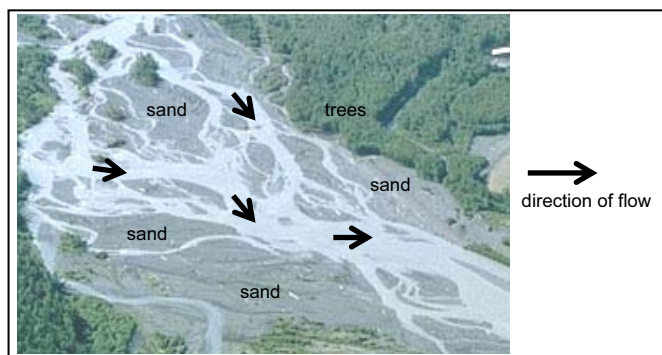
[Adapted from <http://www.civil.northwestern.edu/people/dowding/airphoto/scan/a2a.gif>]

- 4.1 Define the term *drainage density*. (1 × 1) (1)
- 4.2 What evidence indicates that **A** has a higher drainage density than **B**? (1 × 1) (1)
- 4.3 Determine the stream order at point **X**. (1 × 2) (2)
- 4.4 Why will the stream order be higher at point **Y**? (1 × 2) (2)
- 4.5 Explain the influence of vegetation on drainage density. (2 × 2) (4)
- 4.6 As urban development takes place, the drainage density of the surrounding natural environment will increase. Explain why this is the case. (2 × 2) (4)



QUESTION 5

Refer to the photograph below of a river channel pattern, and answer the questions that follow.

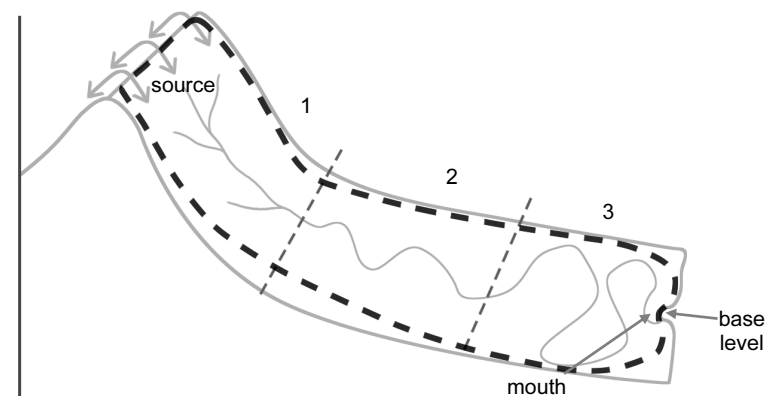


[Adapted from http://www.geologyclass.org/Stream%20Concepts_files/image002.jpg]

- 5.1 Name the river channel pattern in the photograph. (1 × 1) (1)
- 5.2 State ONE stream process that would have encouraged the formation of this stream channel pattern. (1 × 1) (1)
- 5.3 In which course of the river would you find the stream channel pattern in the photograph? (1 × 1) (1)
- 5.4 Describe the process involved in the river breaking up into smaller channels. (2 × 2) (4)
- 5.5 Analyse the role that the trees would have played in the stream discharge. (2 × 2) (4)
- 5.6 Suggest, with a reason, whether the stream channel pattern in the photograph would be found permanently, or seasonally, in rivers in the interior of South Africa. (2 × 2) (4)

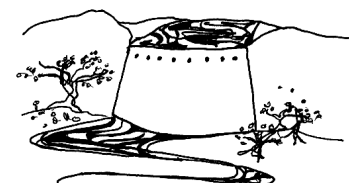
QUESTION 6

Study the diagram below which shows the longitudinal profile of a graded river.



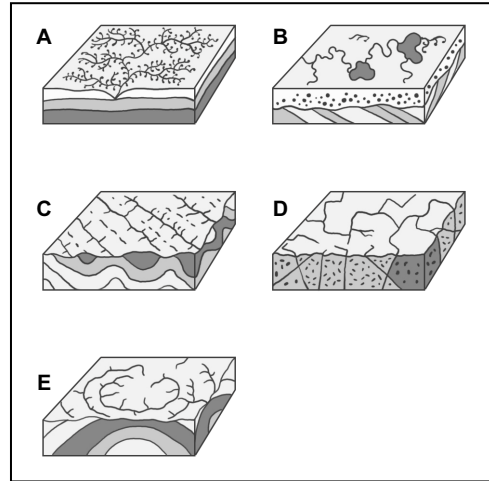
[Adapted from Yorkshiredalesrivertrust.com]

- 6.1 What is meant by the term *base level* of a river? (1 × 1) (1)
- 6.2 Why is the sea regarded as a permanent base level? (1 × 2) (2)
- 6.3 What evidence in the diagram indicates that this river is graded? (1 × 2) (2)
- 6.4 Why will a drop in sea level change the grading of the river? (2 × 2) (4)
- 6.5 Draw a simple longitudinal profile to show the impact of the drop in sea level, mentioned in Question 6.4, on the shape of the longitudinal profile. (1 × 2) (2)
- 6.6 Explain how the interaction between erosion and deposition in the upper and lower courses of a river help to maintain a graded profile. (2 × 2) (4)



QUESTION 7

Refer to the diagram alongside showing different drainage patterns and match EACH of the descriptions below with one of the drainage patterns A to E. You may choose the same drainage pattern more than once.



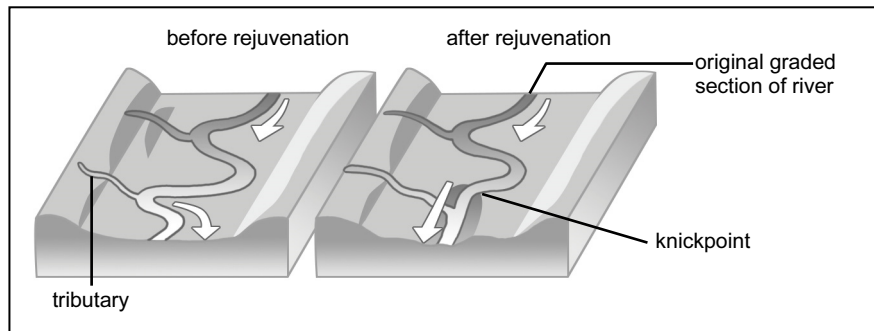
[Adapted from Geography GCSE]

- 7.1 The stream pattern associated with rocks that have equal resistance to erosion
- 7.2 Main streams that are parallel to each other
- 7.3 Main streams that have 90° bends along its course
- 7.4 Streams with an irregular pattern
- 7.5 Rivers flowing away from a central point
- 7.6 A drainage pattern that forms on rocks that have varying resistance to erosion due to folding
- 7.7 Tributaries join the main stream at an acute angle

(7 × 1) (7)

QUESTION 8

Study the diagram below which illustrates river rejuvenation.



[Source: <http://www.alevelgeography.com/wp-content/uploads/2013/11/inc2.g>]

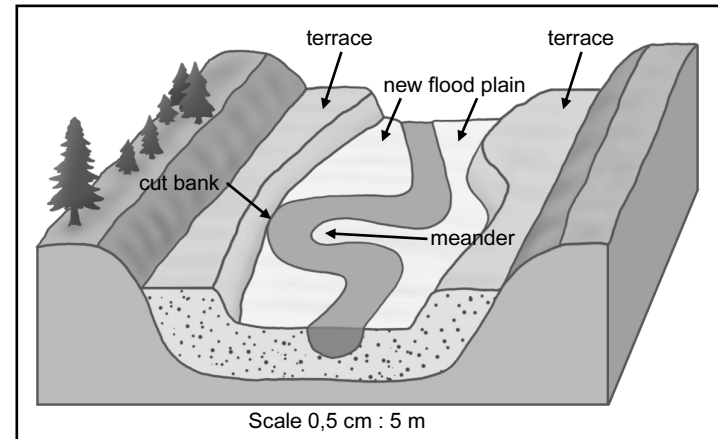
- 8.1 Define the term *river rejuvenation*.

(1 × 1) (1)

- 8.2 State ONE condition that results in river rejuvenation. (1 × 2) (2)
- 8.3 What does a knickpoint indicate on a river profile? (1 × 2) (2)
- 8.4 How does river rejuvenation impact on the grading of a river? (1 × 2) (2)
- 8.5 In a paragraph of approximately EIGHT lines, describe, with reasons, the changes that will occur in the fluvial features found in the lower course of the river as a result of river rejuvenation. (4 × 2) (8)

QUESTION 9

Study the diagram below based on river rejuvenation in the lower course of a river.



[Adapted from www.studyblue.com]

- 9.1 State ONE characteristic of a rejuvenated river. (1 × 1) (1)
- 9.2 What evidence in the sketch indicates that the river has been rejuvenated? (2 × 1) (2)
- 9.3 Give TWO possible causes of river rejuvenation. (2 × 2) (4)
- 9.4 Describe the impact that rejuvenation will have on the meander in the diagram. (1 × 2) (2)
- 9.5 Suggest ONE negative impact of rejuvenation on the future development of infrastructure. (1 × 2) (2)
- 9.6 Give evidence in the diagram to support the statement that terraces, even though they are flat, are not always suitable for farming. (2 × 2) (4)

QUESTION 10

Read the following extract, based on river catchment areas in South Africa.

CASE STUDY ON RIVER MANAGEMENT: SOUTH AFRICAN CATCHMENTS AREAS

Covering many South African river basins, the 'Working for Catchments' programme operates in all major catchment areas.

65% of South Africa receives less than 500 mm average annual rainfall, meaning that drought is an ever-present risk in South Africa.

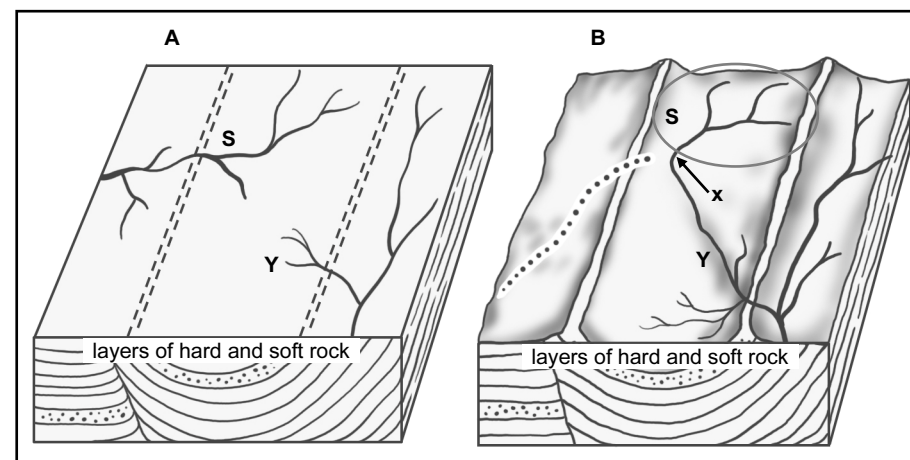
Future projections indicate that by 2025 the country's water requirements will outstrip water supply unless urgent steps are taken to manage the resource more sustainably. There are already major problems of water supply and water quality, with an estimated 8 million South Africans currently having no access to potable water.

[Adapted from http://wwf.panda.org/about_our_earth/about_freshwater]

- 10.1 What is a *catchment area*? (1 × 1) (1)
- 10.2 What evidence in the article indicates that drought is an ever-present risk? (1 × 2) (2)
- 10.3 Give ONE reason for the destruction of catchment areas. (1 × 2) (2)
- 10.4 Suggest TWO steps that need to be taken by the government and non-governmental organisations (NGOs) to manage catchment areas that are at risk. (2 × 2) (4)
- 10.5 Discuss the negative impact of poor catchment management practices for South Africa. (3 × 2) (6)

QUESTION 11

Refer to the diagrams below that show river capture on a superimposed landscape.



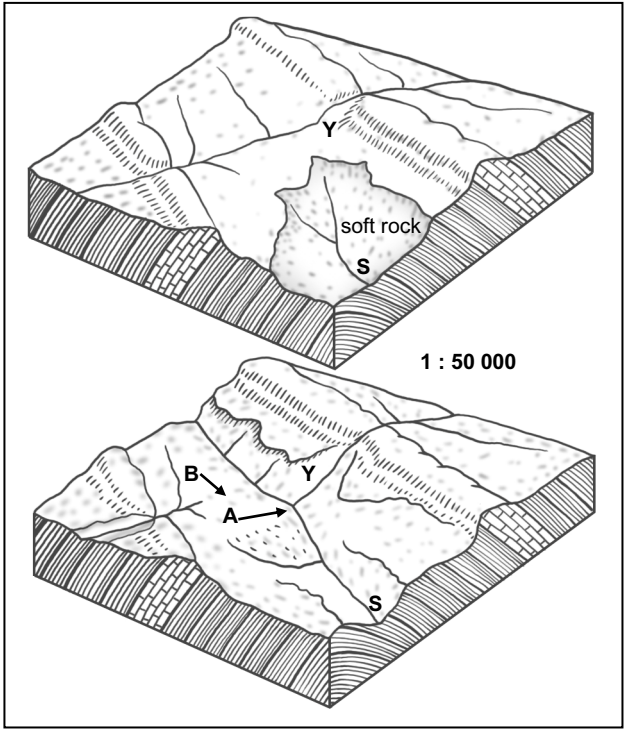
[Adapted from www.uky.edu]

- 11.1 What is a *superimposed stream*? (1 × 1) (1)
- 11.2 What evidence suggests that river **S** and river **Y** are superimposed streams? (1 × 2) (2)
- 11.3 Draw a labelled cross-section to show how the abstraction process resulted in river capture in diagram B. (2 × 2) (4)
- 11.4 In a paragraph of approximately EIGHT lines, explain the changes that the captured stream will undergo downstream of the elbow of capture. (4 × 2) (8)



QUESTION 12

The following diagrams indicate river capture (stream piracy).



[Adapted from www.usgeologicalsurvey.com]

- 12.1 Label **S** and **Y** with the terms 'captor stream' and 'captured stream' respectively. (2 × 1) (2)
- 12.2 Name the features of river capture at **A** and **B** respectively. (2 × 1) (2)
- 12.3 Give TWO reasons for river **S** eroding at a faster rate. (2 × 2) (4)
- 12.4 In a paragraph of approximately EIGHT lines, explain the impact of river capture on the volume of water and the erosive ability of rivers **B** and **S** respectively. (4 × 2) (8)

QUESTION 13

Study the list of some tips from the Department of Water Affairs for the sustainable management of catchment areas and drainage basins in South Africa, and then answer the questions that follow.

South Africa needs to balance the demand for water with the availability of water.

There are a number of ways in which to prevent the overexploitation of water resources:

1. Removing alien vegetation
2. Interbasin transfer schemes
3. Managing groundwater supplies
4. Recycling water
5. Conserving wetlands
6. Preserving vegetation cover

[Adapted from www.dwaf.gov.za]

- 13.1 Define the term *over-exploitation*. (1 × 1) (1)
- 13.2 What is a catchment area? (1 × 1) (1)
- 13.3 Explain how removing alien vegetation will help to prevent the over-exploitation of water resources in South Africa. (2 × 2) (4)
- 13.4 How does the conservation of wetlands contribute to the sustainable management of a drainage basin? (1 × 2) (2)
- 13.5 Discuss the importance of preserving vegetation cover in a drainage basin. (3 × 2) (6)

3: RURAL AND URBAN SETTLEMENT

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UNIT 1

STUDY OF SETTLEMENTS

Concepts of settlement, site and situation

Settlement

- ▶ A settlement is a place where groups of people live in either a rural or urban environment.
- ▶ It is a place where there are buildings used for specific functions.
- ▶ People in a settlement regularly interact with each other, and with the surrounding environment.
- ▶ A settlement is categorised as either **rural** or **urban**.

Site

- ▶ Site is the actual place on which a settlement is built.
- ▶ **Factors that influence the site of a settlement:**
 - › Physical factors, e.g. water, fertile soil, grazing
 - › Economic factors, e.g. minerals
 - › Trade and transport factors, e.g. natural harbour, bridging point of a river
 - › Social factors, e.g. Israeli moshav which is a planned settlement for communal living and agriculture
 - › Political factors, e.g. government policies such as communism
 - › Historical factors, e.g. defensive sites



Situation

- The situation is the position of a settlement in relation to the surrounding environment, e.g. Hex River Valley, Western Cape.

Rural and Urban settlements

- **Rural**: areas in the countryside where people are engaged in primary activities such as farming, fishing, mining, forestry.
- **Urban**: a built-up settlement, like a city or town, where people are involved in secondary, tertiary and quaternary activities.



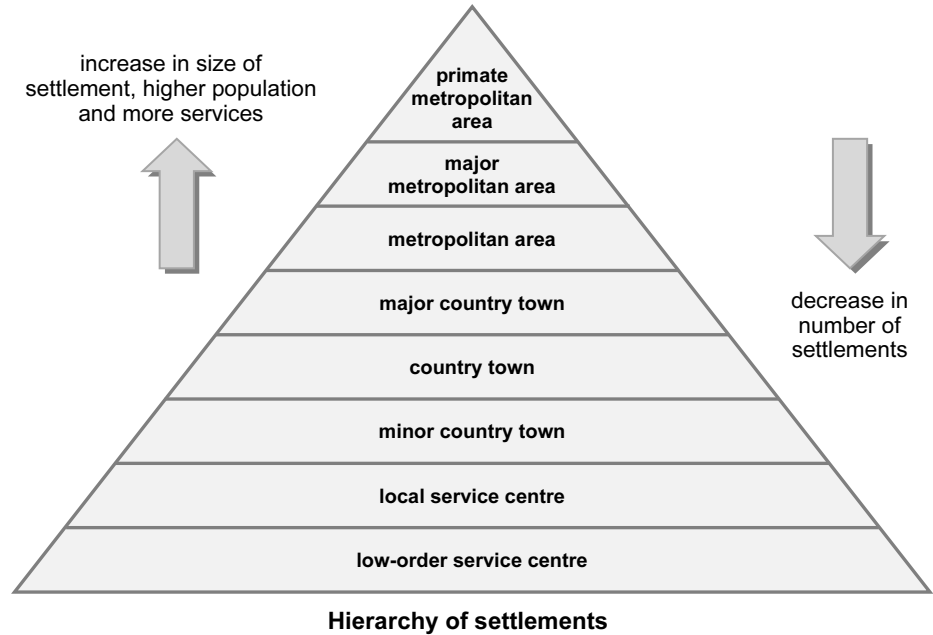
Secondary activities	manufacturing of finished goods, e.g. textiles, chemicals, metalworking, construction
Tertiary activities	provision of services including banking, tourism, media, entertainment, sales, etc.
Quaternary activities	intellectual activities linked to government, research, education, etc.

- Rural settlements are located in the countryside and are usually **unifunctional**.
- Urban settlements are located in towns or cities and are **multifunctional**.



Classification of settlements according to size and complexity, pattern and function

Size and Complexity



Pattern

- The pattern of a settlement is either **dispersed** or **nucleated**.

Function

- All settlements have a function. This determines its main activities.
- The original function of many settlements has changed over time.

How site and situation affect the location of rural settlements

- ▶ A good site will have the availability of:
 - ▶ drinking water from rivers or natural springs
 - ▶ arable land
 - ▶ grazing (pasture) for livestock
 - ▶ building materials
 - ▶ fuel for cooking purposes
 - ▶ transport routes
- ▶ Other influencing factors are:
 - ▶ quality of the soil
 - ▶ relief and drainage
 - ▶ defence – usually on high vantage points
 - ▶ political and administrative needs – where a village becomes the residence of local governor/chief or regional headquarters of a central government
 - ▶ minerals – a mine attracts people to the area

Wet-point settlements:

sites close to water



Dry-point settlements:

sites chosen to avoid water, because of a danger of flooding

Classification of rural settlements according to pattern and function

The following patterns will emerge:

- ▶ Rural settlements show a **dispersed** pattern (displayed on maps as a square or dot that consists of the main house and outbuildings), or a **nucleated** pattern (squares or dots that show buildings grouped together, as in a village).



Dispersed pattern



Nucleated pattern

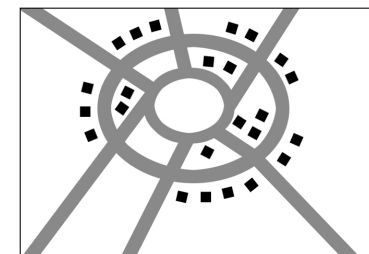
Reasons for different shapes of rural settlements

- ▶ Most nucleated settlements are classified according to their specific shape.
- ▶ Many physical, human and cultural factors influence these shapes.
- ▶ These include the:
 - ▶ relief of the area (mountains, rivers, plains)
 - ▶ transport routes (roads)
 - ▶ safety (defence), etc.

There are **four basic shapes**:

Round or circular

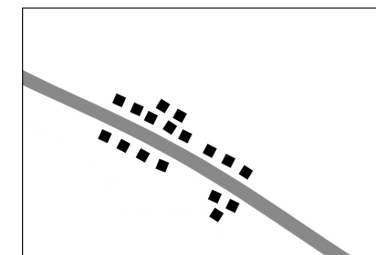
Round villages develop for defensive reasons or around a central feature, e.g. common land, village green, a well or church.



Round village

Linear

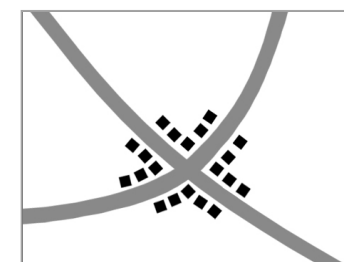
Linear villages develop along a road or river.



Linear village

Crossroad

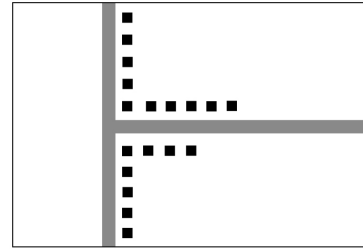
Crossroad villages develop at a crossroad (intersection) and develop in a star shape.



Crossroad village

T-shaped

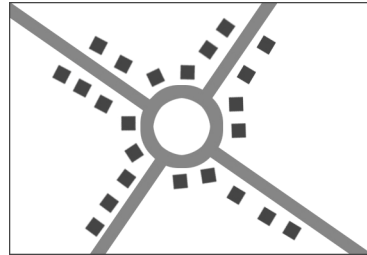
T-shaped villages develop at a T-junction in a road.



T-shaped village

Stellar

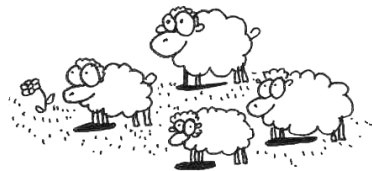
Stellar villages develop in a star-shape due to growth along radiating transport routes.



Stellar village

Land-use in rural settlements

- ▶ The land-use depends on the function and the type of primary activities that occur in and around the settlement.
- ▶ Environmental factors (soil type, climate, topography) determine the types of crops or animals that can be farmed.
- ▶ Economic factors may influence the land-use, such as the size of land required to make a living, the distance to market for the sale of goods and so on.
- ▶ Social factors and culture may influence how the rural land is used, e.g. in communities where cattle represent wealth, they may be the main rural activity. Many rural areas are becoming more urbanised.
- ▶ The land-use for a settlement involved in agriculture could include houses in which people live, storage buildings and sheds, grazing land, roads, water storage facilities etc.



UNIT 3

RURAL SETTLEMENT ISSUES

Rural-urban migration

Rural-urban migration

people leave the rural areas to live in urban areas; this is taking place on a global scale, especially in developing countries



Rural depopulation



Rural depopulation

rural areas become depopulated, resulting in a decline of functions and services; towns become 'ghost towns'

Causes of rural depopulation on people and the economy

- ▶ Poverty is the most important reason for rural depopulation.
- ▶ In developing areas, the rural poor are very isolated because of:
 - › distance from urban services
 - › lack of basic services (electricity and clean water)
 - › poor health care
 - › few educational opportunities
 - › few employment opportunities

Push factors

These factors push people **away** from rural areas and include:

- ▶ Natural disasters e.g. droughts, famine.
- ▶ Crop failures due to droughts, floods or famine.
- ▶ Limited food production because of overgrazing or misuse of arable land, resulting in soil erosion or soil exhaustion.
- ▶ Lack of jobs due largely to mechanisation (modern machinery) – farms need fewer labourers.
- ▶ Basic services close down, such as medical, educational (schools), and banking services.
- ▶ Low standard of living and poor quality of life.
- ▶ Lack of safe (clean) water.

Pull factors

These factors pull people **towards** the urban areas and include:

- ▶ Employment.
- ▶ Education – better schools and educational opportunities.
- ▶ Industries and services in cities offer employment opportunities.
- ▶ Better services such as health care and entertainment.
- ▶ Expectation of better housing and better quality of life.
- ▶ More reliable sources of food.
- ▶ Factory workers are usually paid more than farm workers and are not as affected by natural disasters, e.g. drought.
- ▶ Expectation of a constant supply of clean water and sanitation.

Consequences of rural depopulation on people and the economy

- ▶ Farmers and residents spend less in the smaller service centres as they prefer to shop in the larger service centres.
- ▶ As a result, the smaller centres struggle to survive economically.
- ▶ Young men usually leave first and the women and elderly remain behind. The rural population starts to become older.
- ▶ As a result, the process of rural decline and decay sets in.

Strategies to address the effects of rural depopulation

Developing countries all over the world have problems with rural depopulation and dwindling economies. South Africa is no exception and also suffers from the inequalities of apartheid policies that kept rural people in a state of poverty.

Rural settlement problems in South Africa

- ▶ Rural depopulation is a global phenomenon, but many of the problems in South Africa stem from discriminatory legislation and the neglect of the majority black population during apartheid.
- ▶ Forced removals led to overpopulation in the rural areas and deprived people of basic needs.
- ▶ High population growth put further pressure on limited family incomes, social services and on the natural resources.

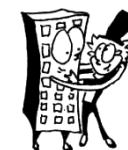


South Africa has put in place several programmes and policies to redress this situation.

Reconstruction and Development Programme (RDP) – 1994

The focus was on:

- ▶ meeting basic needs
- ▶ developing human resources
- ▶ building the economy
- ▶ creating a democratic state and society



GEAR

GEAR

Growth, Employment and Redistribution



It replaced the RDP in 1996. This economic reform plan was directed towards:

- ▶ growing an economy to create sufficient jobs
- ▶ redistribution of income opportunities in favour of the poor
- ▶ ensuring the availability of good health, education and other services
- ▶ creating environments where homes and places of work are safe

Comprehensive Rural Development Programme (CRDP)

CRDP is presently being implemented in South Africa.

It aims to:

- ▶ eliminate rural poverty and food insecurity
- ▶ maximise the use and management of natural resources
- ▶ create sustainable rural settlements

This aims to be achieved by the implementation of land reform policies, stimulating agricultural production, improving service delivery and rural infrastructure, skills development, development programmes for rural transport and so on.

Social justice issues in rural areas, such as access to resources and land reform

- ▶ Social justice is the principle that all individuals are entitled to their basic human needs: food, water, clothing, shelter, health care and education.
- ▶ The Native Land Act of 1913 had a major impact on rural areas in South Africa. Black South Africans were assigned only 13,6% of the land. These areas were called reserves and later became known as homelands.
- ▶ In the 1950s the government passed laws stating that all black South Africans had to live in a homeland unless they had a pass allowing them to leave.
- ▶ The previous homeland areas have very poor soil conditions caused by overuse of the land which has resulted in severe degradation.
- ▶ Many of the social injustices in the rural areas are caused by the lack of easy access to resources.
- ▶ Poverty is a huge problem in the rural areas. Subsistence farming is practised. Poor soil fertility contributes to poverty.

- ▶ Gender inequality and lack of basic education have increased the unemployment rates.
- ▶ Access to primary healthcare is limited. HIV/Aids and tuberculosis (TB) are widespread in South Africa's rural areas.
- ▶ Rural infrastructure is poor. There is limited access to sanitation and water in many rural areas.

In South Africa the current land ownership and development patterns still reflect much of the economic and political conditions of apartheid. The government believes that granting land ownership to communities and people in rural areas can help to alleviate poverty.

Here are some of the strategies used in this plan:

Land redistribution

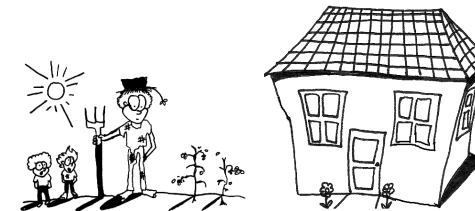
Land owned by the government is allocated to disadvantaged and poor people (especially in rural areas) for settlement and farming.

Land restitution

Land that was forcibly removed from people under various discriminatory laws is returned to them. People lodge claims through the Land Claims Court who then decide on an outcome.

Land reform

People are given the security of land tenure/occupancy, including communal land ownership and informal ownership (by farm workers and labour tenants), as some labour tenants have lived on the same land for generations and have no other home.



Origin and development of urban settlements

- ▶ All settlements were originally rural.
- ▶ The low productivity of agriculture meant that towns could not prosper on the income derived from farming and so they had to manufacture goods to trade.
- ▶ Villages became established and eventually grew into towns and then cities.
- ▶ The earliest urban settlements were established 6 000 years ago.
- ▶ Initially the proportion of the world's population living in urban settlements was very small but in recent times this has risen dramatically.
- ▶ 50% of the world's population was urban by 2010.
- ▶ One of the main reasons for urbanisation is the transition from an economy based on primary activities to a system where secondary and tertiary activities become more important.

Urbanisation	process where the ever-increasing percentage of the total population lives in urban rather than rural settlements
Urban growth	the increase in the number of people living in a city
Urban expansion	refers to the physical or real growth of an urban settlement linked to the increase in the urban population numbers
Urban sprawl	refers to the haphazard expansion of low-density residential developments
Rate of urbanisation	the average rate of change of the size of the urban population over a given period of time
Level of urbanisation	the percentage of the total population living in urban settlements at a given time



How site and situation affect the location of urban settlements

Several factors influence the site and situation of urban settlements:

Human factors

- ▶ historical, e.g. defence
- ▶ social, e.g. need for social interaction
- ▶ political, e.g. nucleated for safety in times of war or political instability or nucleated as a result of policy, e.g. communism
- ▶ cultural, e.g. communal living

Economic factors

- ▶ transport and trade

Physical factors

- ▶ climate
- ▶ relief
- ▶ water supply and drainage of the land



Classification of urban settlements according to function

An urban settlement can be **classified** according to its **function**. However, this original function may change over time as new needs and services are provided.

Types of urban settlements

Central places

- ▶ Develop because of the surrounding rural population's need for certain goods and services, usually found in urban areas.
- ▶ These services include social, economic, health, education and religious needs.
- ▶ Most towns in the interior of South Africa (e.g. Karoo and Free State) originated as central place towns.

Trade and transport cities

- ▶ Cities originate where transport routes meet. They are often along transport routes such as navigable rivers, major road transport routes or where one form of transport is replaced by another, e.g. sea to rail.
- ▶ There are **3 types** of trade and transport cities:
 - ▶ **Break-of-bulk points**
Develop at a point where the type of transport changes, e.g. at a harbour where the transport changes from sea to road or rail.
 - ▶ **Junction towns**
Originate where important transport nodes meet, such as road, river or railway junctions, e.g. De Aar (rail junction).
 - ▶ **Gateway/gap towns**
Originate at places where there are physical barriers, such as mountain passes, e.g. Worcester or low-water river crossings.

Specialised cities

- ▶ Usually have one dominant function, e.g. mining, recreation, military, industry, e.g. Sasolburg (oil from coal), Phalaborwa (copper mining).
- ▶ Resources are generally strongly localised.
- ▶ Tend to originate in clusters, e.g. along safe beaches, coal fields, gold fields, etc.



UNIT 5

URBAN HIERARCHIES

Hierarchy

a number of levels ranging from low to high; each level offers a similar set of functions; however, each level will be ranked above the other



Central Place Theory

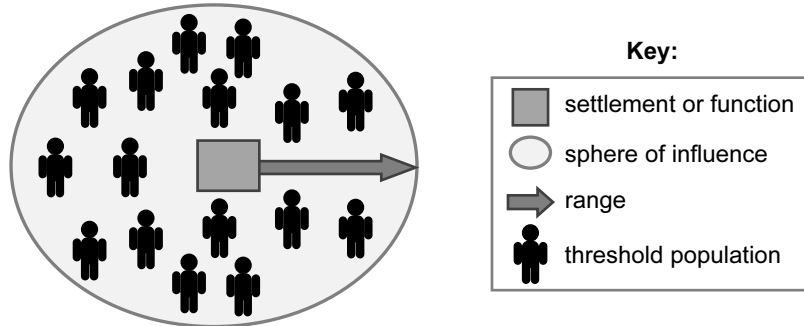
- ▶ In 1933, the German, Walter Christaller, developed the Central Place Theory.
- ▶ He observed that the towns in northern Germany displayed a regular distribution pattern.
- ▶ His Central Place Theory explained the number, location, size, distribution and function of the urban settlements.
- ▶ There are **four main principles** to this theory:
 - ▶ People prefer convenience.
 - ▶ People want to pay the cheapest price for goods.
 - ▶ Businesses want to make as much profit as possible.
 - ▶ People prefer to pay the minimum travelling costs when making a purchase.

Central place	an urban settlement that provides goods and services to the surrounding population
Threshold population	the minimum number of people required to support a business or service
Sphere of influence	the area from which a business draws its customers
Range of goods	the maximum distance a person will travel to buy goods



- ▶ The smaller the settlement, the smaller the threshold population, the range and sphere of influence.
- ▶ The larger the population of a settlement, the more able that population is to support a larger variety of services and functions.

- ▶ There are more small settlements than large settlements.



Central Place Theory Concepts

Low and high order functions and services

- ▶ **Low-order goods/services** are generally cheaper convenience goods needed on an everyday basis located in local convenient outlets, e.g. bread and milk.
- ▶ **High-order goods/services** are more specialised and expensive goods and services needed less frequently and generally located only in larger centres.

Low and high order centres

- ▶ Urban settlements can be arranged in a **hierarchy** (system of ranking) according to their size and functions: low and high order centres.
- ▶ A South African geographer, Professor RJ Davies, used some of the ideas of the Central Place Theory to classify South African cities into an urban hierarchy.
- ▶ In 1967 he classified urban settlements into eight hierarchical categories.



Classification	Examples
Primate metropolitan area	Johannesburg-Pretoria conurbation (Tshwane)
Major metropolitan area	Cape Town, Durban
Metropolitan area	Bloemfontein, East London, Port Elizabeth, Kimberley, Pietermaritzburg, Vereeniging
Major country town	Nelspruit (Mbombela), Grahamstown (Makhanda), Oudtshoorn, Queenstown (Komani)
Country town	Beaufort West, Upington, Eshowe
Minor country town	Bredasdorp, Musina
Local service centre	Barrydale, Colenso
Low-order service centre	Wilderness, Clarens

Conurbation	a continuous urban area, e.g. Witwatersrand (linking Johannesburg, Boksburg, Brakpan, Benoni, Randburg, Sandton, Soweto, Midrand, Pretoria)
Megalopolis	formed when conurbations join together, e.g. eastern seaboard of the USA – over 1 000 km linking New York, Boston, Philadelphia, Baltimore and Washington DC



UNIT
6

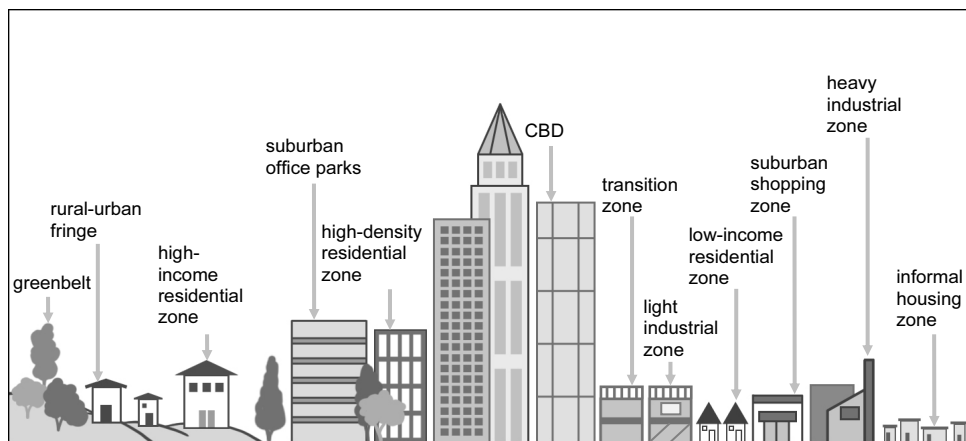
URBAN STRUCTURE AND PATTERNS

Internal structure and patterns of urban settlements

Land-use zones

Land-use zone

refers to a type of function (or service) that is found in that area



Land-use zones

CBD

Central Business District



Commercial zone (CBD)

- ▶ Located near the city centre where land is scarce and land values are very high.
- ▶ Concentration of high-rise buildings (skyscrapers) due to limited space.
- ▶ The CBD is the most accessible area because all roads and railways converge here.
- ▶ Very intensive land-use creates high volumes of traffic.
- ▶ Predominantly high-order functions.
- ▶ Commercial and financial activities.

Transition zone (zone of decay)

- ▶ Most often located around the older parts of the CBD.
- ▶ Different functions, including retail, commercial and residential.
- ▶ Buildings are 'run down'.
- ▶ High land values.

High-density residential zone

- ▶ Found on the perimeter of the CBD and sometimes in neighbouring suburbs.
- ▶ Generally consists of high-rise buildings (flat complexes), e.g. Sea Point.
- ▶ Due to urban decay, some are overcrowded, poorly maintained, and a source of crime.

Light industrial zone

- ▶ Small to medium industries, e.g. manufacturing of furniture, electronic equipment, printing, bakeries.
- ▶ Require good transport networks and quick access to the CBD or shopping centres.
- ▶ Do not produce much pollution.

Low-income residential zone

- ▶ Generally located near the CBD.
- ▶ Also located on the outskirts of a city (if planned, called dormitory towns, if not planned, called squatter camps).
- ▶ Legacy of apartheid and urbanisation created these zones.

Suburban shopping zone

- ▶ Generally situated in residential areas away from the CBD.
- ▶ Customers require parking areas and road networks for maximum accessibility.
- ▶ Trend is to locate these functions on fringes of city with rooftop parking or parking garages.

Suburban office parks

- ▶ Office parks located away from the CBD with sufficient parking, sometimes in the rural-urban fringe.
- ▶ Attractive zones with landscaped environments, accessible by road transport, e.g. Century City near Cape Town.

Heavy industrial zone

- ▶ Located far away from the CBD and high-income residential areas because of air and noise pollution, industrial hazards and dangers.
- ▶ Require heavy transport (rail and mass road transport).
- ▶ Buildings require large areas with lower land values.

Informal housing zone

- ▶ Usually in rural-urban fringe.
- ▶ High density informal houses with limited access to basic services, such as clean water and sanitation.

High-income residential zone

- ▶ Located away from the CBD and industrial zones.
- ▶ Associated with high land values and single dwellings on large plots with pleasant environments and views.
- ▶ In South Africa, crime has given rise to cluster housing in security complexes and golf estates.

Rural-urban fringe

- ▶ On the outskirts of urban areas.
- ▶ Mixed functions need large spaces with lower land values, e.g. golf courses, nurseries, market gardens, cemeteries, airports.

Greenbelt

- ▶ Area of parks, farmland or uncultivated land surrounding (or within) a city.

Urban profile

- ▶ An urban profile shows the vertical shape of a city skyline when viewed from the side.



Cross section of a typical urban profile

Reasons for shape of urban profile

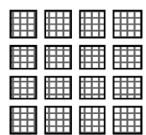
- ▶ A concentration of high-rise buildings is usually located towards the centre of the city. Buildings are tall and vertical because of high land values and the scarcity of land for building purposes and extension.
- ▶ Many cities have a second concentration of high-rise buildings away from the city centre. This is usually the flat and hotel district.
- ▶ Towards the outskirts of the city, land values are lower. Large buildings extending horizontally are located in these areas comprising of warehouses, factories and office parks.
- ▶ Residential areas consisting mostly of single storey houses/informal settlements.
- ▶ Vacant areas may also be located in between the different zones because of building restrictions; conservation areas; green belt zones; and recreation zones (golf courses).

Factors influencing the morphological structure of a city

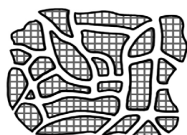
- ▶ The shape of cities is largely dependent on the physical site of the city, land values, transport routes and economic factors.
- ▶ Most cities tend to be roughly **circular** in shape as it means that the total amount of movement within the city is kept to a minimum.
- ▶ However, some cities have different shapes that often reflect their origin, growth and functions. These shapes can be directly linked to some form of relief barrier or human activity:
 - ▶ The **geometrical shape** was characteristic of the Middle Ages and the Renaissance. Many fortress cities were planned in a geometrical shape.
 - ▶ Access to private motor vehicles has been the most significant influence on the shape of cities.
 - ▶ In the 20th century, many urban settlements developed a roughly **stellar/star shape** with new extensions radiating in several directions along main roads and transport routes.
 - ▶ Other settlements have **linear shapes** due to relief barriers such as along rivers, at a coastline or in valleys between two parallel mountains.

Street patterns

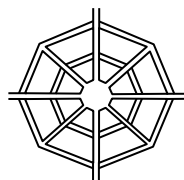
- ▶ Streets can be regarded as the skeleton of an urban settlement.
- ▶ Streets can be used to identify different zones, and the age of the settlement.
- ▶ Most urban settlements have a combination of different street patterns.
- ▶ This is the result of the age of the city, planning and relief.



Grid



Irregular



Radial concentric

Different street patterns

Grid (gridiron) pattern

- ▶ Streets intersect at right angles to each other.
- ▶ Typical of older settlements and in the CBD because pedestrian traffic was important.
- ▶ **Positives:**
 - ▶ Easy to survey, plan and extend.
 - ▶ Easy to subdivide land into plots and to construct buildings.
 - ▶ Easier to lay down networks for water, electricity and telephones.
- ▶ **Negatives:**
 - ▶ The many intersections can lead to traffic congestion.
 - ▶ Not suitable where the land is steep.

Irregular (planned or unplanned)

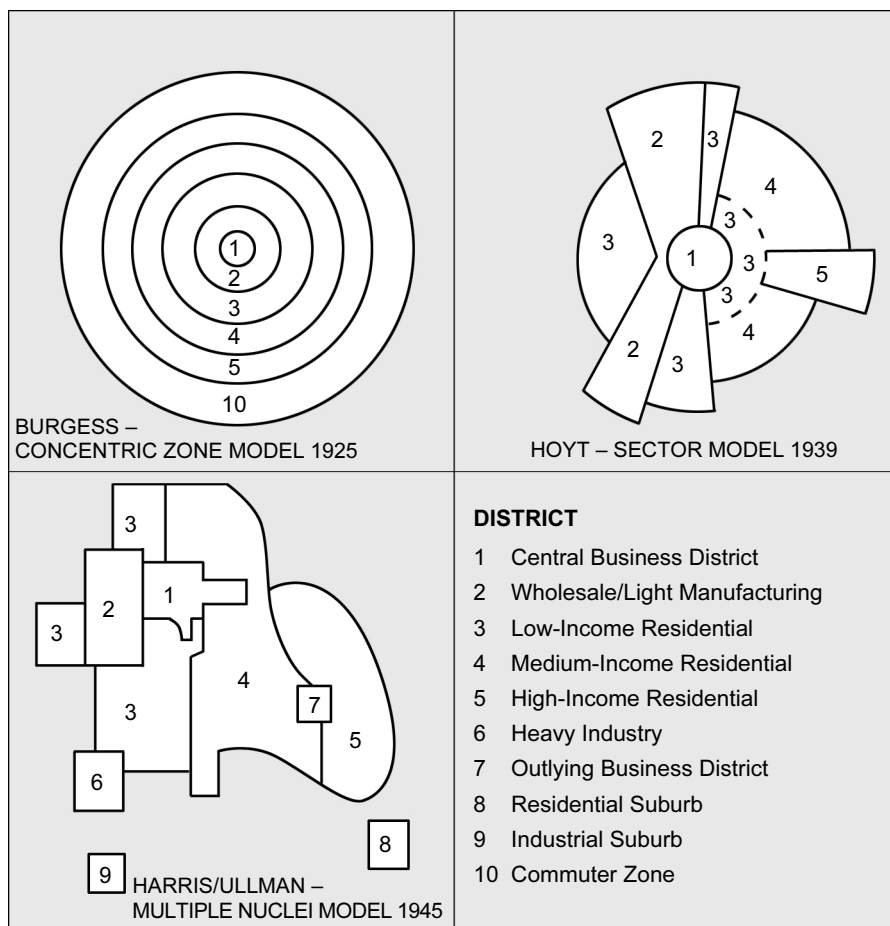
- ▶ **Planned irregular patterns** are more typical of the modern era; they were used to break the monotonous gridiron pattern.
- ▶ Newer suburbs have circles and circular drives, especially in hilly areas where the relief influences such planning.
- ▶ **Positive:**
 - Allows for smooth and uninterrupted flow of traffic.
- ▶ **Unplanned irregular pattern** is the result of a lack of planning, resulting in a maze of streets with various widths and directions. Street blocks of all shapes and sizes, found especially in older cities of Europe, rural areas and informal settlements, e.g. centre of Kimberley.
- ▶ **Negative:**
 - Streets may be very steep along steep gradients and result in pedestrian and transport flow problems.

Radial concentric pattern

- ▶ All roads lead to a central accessible point.
- ▶ Many old cities of Europe have this pattern. Boulevards replaced the old city walls.
- ▶ **Positive:**
 - Ensures smooth flow of traffic.
- ▶ **Negative:**
 - Confusing, easy to get lost.

Models of Urban Structure

- ▶ Geographers have attempted to explain land-use zones in urban places by means of models. Planning for future growth is done using models of existing cities.
- ▶ There are **three classic models** of land-use zones:



Comparing the models		
Burgess (Concentric) 1925	Hoyt (Sector) 1939	Harris/Ullman (Multiple nuclei) 1945
Zones concentric around CBD	Zones in sectors radiating from CBD	Various nuclei with CBD not centrally placed
▶ transition zone followed by lower-income, then higher-income and commuter zones	▶ zones radiate from CBD along transport routes ▶ higher-income zones away from industrial zones ▶ low-income zones near to light industrial and wholesale zones	▶ makes provision for outlying business zones ▶ residential and industrial areas influenced by centripetal and centrifugal forces

Modern American - Western city

- ▶ All Western cities have an orderly structure, where we can find the different functions and particular zones in more or less the same part of the city.
- ▶ Most are a multi-nodal city with an old CBD, new secondary urban cores and large suburbs, gated estates and edge cities.
- ▶ Many businesses move away from the inner city to the secondary nodes and suburbs.

The Third World city

- ▶ The CBD is the main urban core and is surrounded by housing and industrial areas.
- ▶ Large informal settlements are located on the outskirts of the city.

The South African city – changing urban patterns and land-use

- ▶ South Africa has an unnatural system of land-use as a result of the apartheid policies. These have left a racial imprint on South African cities.
- ▶ The Group Areas Act (1952) divided South African cities into separate racial areas. Black people were removed from their homes and relocated in outlying townships. Large townships and informal settlements are found in most parts of South Africa.
- ▶ Many South African inner city areas are in decline with the growth of secondary nodes and suburbs.

UNIT

7

URBAN SETTLEMENT ISSUES**Recent urbanisation patterns in South Africa**

- ▶ South African cities are growing rapidly – especially Johannesburg, Cape Town and Durban.
- ▶ 65% of South Africans live in urban settlements and this percentage is increasing.
- ▶ The average rate of urbanisation is 1,2% per year.
- ▶ The increase in urbanisation is due to both internal migration from within South Africa and also the natural growth of urban populations.
- ▶ South African urbanisation rates have also increased due to migrants from other African cities.

Urban issues related to rapid urbanisation

- ▶ Rapid urbanisation can lead to many challenges or problems:
 - ▶ **Inner city problems**
Urban areas are experiencing a greater demand for employment, basic services and infrastructure. There are many problems that can be seen in the inner city such as: crime, poor housing (slums) and unemployment. Lack of money is often the cause of the problems and they are often seen in the lower income areas of the city.
 - ▶ **Urban blight (urban decay)**
The process by which a previously functioning city or part of a city falls into disrepair. It often occurs in areas with high poverty rates and lack of economic opportunity.
 - ▶ **Traffic congestion**
Rapid urbanisation has resulted in traffic jams, delays, shortage of parking.

▶ **Lack of planning**

Rapid urbanisation can result in many unplanned settlements e.g. informal settlements or building extensions. New urban developments need to be properly planned and managed.

▶ **Overcrowding**

Many cities have high population densities resulting in slums developing and services such as schools and hospitals being under pressure.

▶ **Housing shortages**

The growing size of urban populations leads to a shortage of houses, overcrowding, inadequate services etc.

▶ **Service provision**

Many South African cities are facing a problem of a lack of service provision. Low-income residential areas and informal settlements often lack clean drinking water, electricity, health-care facilities, sanitation, waste disposal, housing and transport systems.

Urban Renewal

- ▶ The redevelopment of areas within a large city, typically involving the clearance of slums.
- ▶ The renewal process can include demolishing old or run-down buildings and constructing new houses.
- ▶ The purpose of urban renewal is to improve the quality of life of residents in urban areas.

**Gentrification (Chelseafication)**

- ▶ The modernisation and improvement of old houses and buildings close to the city centre.
- ▶ Areas can be transformed into trendy, expensive neighbourhoods. The value of these properties can rise considerably.

Growth of informal settlements and associated issues

Informal settlement

an unplanned residential settlement where people have occupied land illegally and built shacks there



- ▶ South Africa's population is becoming increasingly urbanised. There is a shortage of housing resulting in many people living in informal settlements.
- ▶ Most informal settlements lack basic services such as water, electricity and sanitation.
- ▶ There is an increasing number of **backyard shacks** – informal dwellings built alongside formal houses.

Informal settlement issues

- ▶ Shacks are usually made of corrugated iron and are very hot in summer and cold in winter.
- ▶ Many settlements are in low-lying areas and are prone to flooding.
- ▶ Fires occur frequently – caused by candles, paraffin stoves and open fires. They spread rapidly as the shacks are close together. Fire engines cannot gain access as the spaces between the shacks are very narrow.
- ▶ Lack of services. Taps and toilets are often outside and some distance from the houses.
- ▶ Unhealthy living conditions.
- ▶ Poverty and unemployment.



An informal settlement

New towns

- ▶ Settlements are planned right from the start and built on new sites and include all aspects of development before construction begins. This means that:
 - ▶ suburbs, roads, all the land-use zones, parks and amenities are planned in advance
 - ▶ all socio-economic features are integrated, e.g. schools, roads, shopping centres
 - ▶ transport systems such as wide roads, traffic circles, and street patterns are planned to be functional
 - ▶ all functions are regulated by laws
 - ▶ some new towns are built in poorer areas to boost the economy. Others are self-sustainable providing employment, education and health care services, recreation, etc.
- ▶ New towns include **garden cities** and **greenbelt towns**.
 - ▶ These new towns are intended to limit the growth problems of large cities, stimulate economic growth, and provide housing for the growing urban populations. They also help to decentralise urban populations to lessen overcrowding and the pressure on limited city resources.

Self-help cities

- ▶ Communities initiate a 'self-help' approach when local authorities or central governments fail to improve the quality of life of the inhabitants.
 - ▶ In South Africa, a substantial number of foreign and local organisations and volunteers are assisting potential home owners to build their own homes by providing the basic material and helping with the building, e.g. 'Habitat for Humanity'. Inhabitants become skilled in the building trade.

Future urban settlements

Urban settlements in the future need to become more sustainable by:

- ▶ planting more trees, creating parks and greenbelts
- ▶ recycling urban waste
- ▶ using cleaner fuels and energy sources
- ▶ using environmentally friendly building materials
- ▶ establishing food gardens, growing vegetables
- ▶ managing the use of urban water

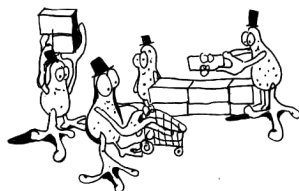


QUESTIONS RURAL AND URBAN SETTLEMENT

QUESTION 1

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1 - 1.8).

- 1.1 A group of people, buildings, infrastructure and communication links that function together as a single, integrated system
- 1.2 The position of a settlement in relation to its surrounding environment
- 1.3 The piece of land on which a settlement is built
- 1.4 This settlement is found in an area where water is scarce and people live close to the water supply
- 1.5 A name given to a city with dependent towns surrounding it
- 1.6 A settlement that develops close to an opening through a physical barrier
- 1.7 The point where one mode of transport is replaced by another
- 1.8 A town that develops where there is a bridge across a river (8 × 1) (8)



QUESTION 2

Choose a term in COLUMN B that matches the description in COLUMN A. Write only the letter (A - H) next to the question number (2.1–2.7), for example 2.8 J.

COLUMN A	COLUMN B
2.1 Rural settlements with one main function	A central place
2.2 A settlement that consists of a few buildings occupied by one family	B nucleated settlement
2.3 A settlement pattern where buildings are placed far apart from each other	C linear
2.4 Farm houses located along a road	D crossroad settlement
2.5 A settlement that provides for the urban needs of the surrounding rural community	E unifunctional
2.6 A settlement that develops at a natural passage in a mountain chain	F dispersed
2.7 A settlement pattern influenced by the way in which roads meet	G isolated farmstead
	H gap town

(7 × 1) (7)

QUESTION 3

Indicate whether EACH of the statements below describes an URBAN or a RURAL settlement. Write only URBAN or RURAL next to the question numbers (3.1 - 3.8).

- 3.1 Unifunctional settlement
- 3.2 Includes towns, cities, a metropolis and a megalopolis
- 3.3 Associated with secondary, tertiary and quaternary activities
- 3.4 Includes farmsteads, hamlets and villages
- 3.5 Displays a dispersed settlement pattern
- 3.6 Has a variety of functions, such as shops, schools and places of worship
- 3.7 Characterised by primary economic activities
- 3.8 Serves the role of a central place (8 × 1) (8)

QUESTION 4

Choose a term from COLUMN B that matches the description in COLUMN A. Write only the letter (A - H) next to the question number (4.1 - 4.7), for example 4.8 J.

COLUMN A	COLUMN B
4.1 Increase in the number of people living in urban areas	A urban morphology
	B urban sprawl
4.2 Zone on the outskirts of the city where urban and rural land-use functions are mixed	C rural-urban fringe
	D urban profile
4.3 Ageing and deterioration of buildings in the inner city	E urban growth
	F urban blight
4.4 Formless expansion of urban areas into the surrounding rural areas	G urban expansion
	H urban hierarchy
4.5 Internal structure of an urban area	
4.6 System of ranking settlements according to size and functions	
4.7 Increase in the size of urban areas	

(7 × 1) (7)



QUESTION 5

Read the following article about urbanisation and then answer the questions that follow.

URBANISATION: LOW-COST HOUSING NOT LOW-COST ENOUGH

11 APRIL 2014, LAUREN ROYSTON, MICHAEL CLARK

There is still no formal plan to cover the need for cheaper inner-city accommodation. Approximately 60% of the South African population currently lives in urban areas. This figure will increase as a result of natural population growth and the further migration of people to cities in search of economic opportunities.

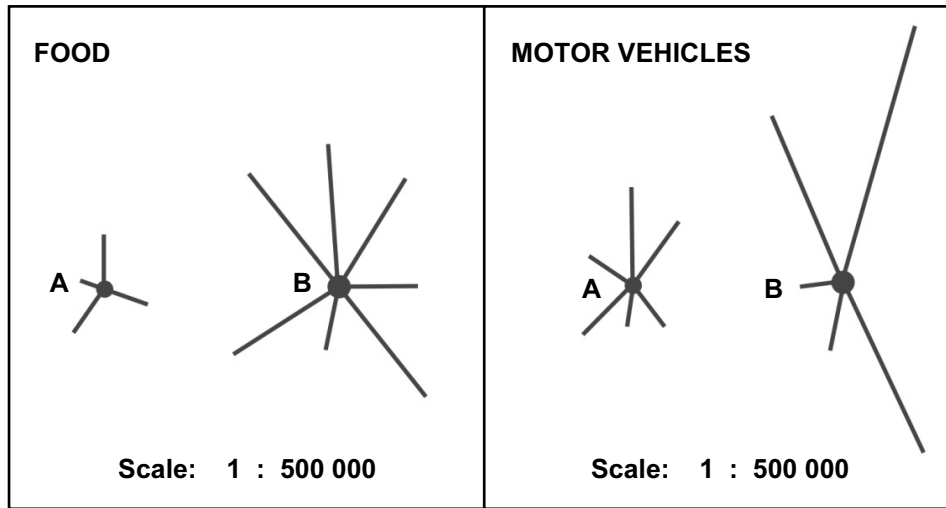
In many African countries, including South Africa, the standard government response to poverty associated with urbanisation (where people live in backyard shacks, informal settlements and 'bad' buildings) has been to focus on improving standards of living in rural areas in order to prevent rural-urban migration, and to criminalise poverty in urban areas by evicting people from their shacks and clamping down on informal livelihoods.

[Adapted from <http://mg.co.za/article/2014-04-10-low-cost-housing-not-low-cost-enough>]

- 5.1 Define the term *urbanisation*. (1 × 1) (1)
- 5.2 Name the percentage of the people living in urban areas in South Africa. (1 × 1) (1)
- 5.3 What are the causes of urbanisation in South Africa? (2 × 1) (2)
- 5.4 Name FOUR problems associated with urbanisation. (4 × 1) (4)
- 5.5 Refer to the 'bad' buildings in the article.
 - (a) Discuss TWO causes of 'bad' buildings. (2 × 2) (4)
 - (b) Suggest TWO possible solutions to the problem of 'bad' buildings. (2 × 2) (4)

QUESTION 6

The diagram below shows the sphere of influence and range of food stores and motor vehicle retailers in settlements **A** and **B**.



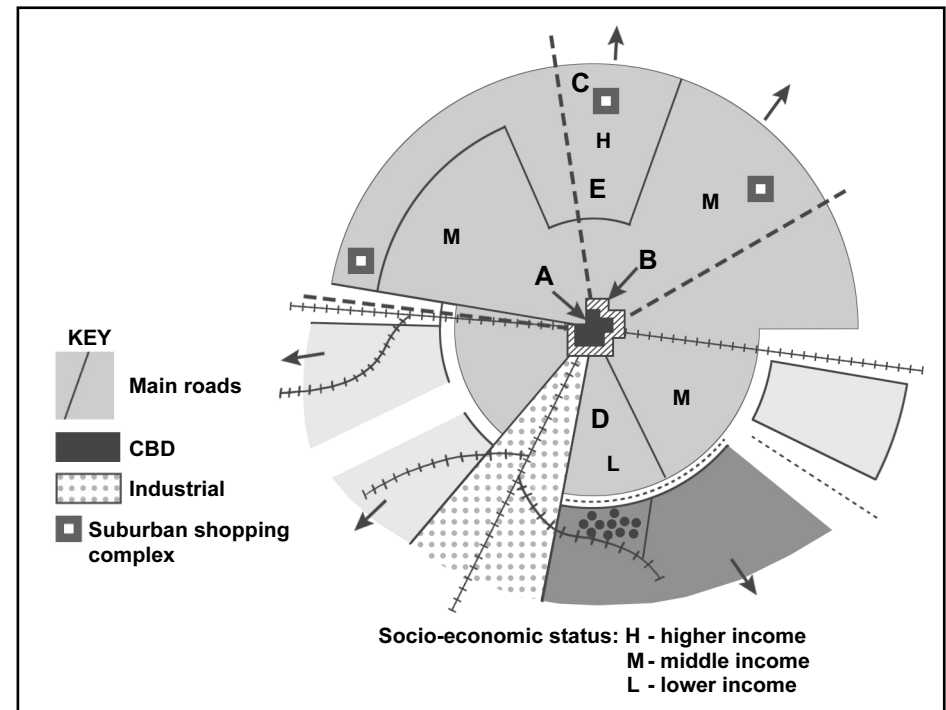
[Source: Examiner's own sketch]

- 6.1 Define the terms *sphere of influence* and *range*. (2 × 1) (2)
- 6.2 Which product, food or motor vehicles, has a larger range? (1 × 1) (1)
- 6.3 Give a reason for your answer to Question 6.2. (1 × 2) (2)
- 6.4 Comment on the threshold population required for motor vehicle sales. (1 × 2) (2)
- 6.5 Describe TWO characteristics of settlement **A**, which is a low-order centre. (2 × 2) (4)
- 6.6 Explain what influences the sphere of influence of a settlement such as **B**. (2 × 2) (4)



QUESTION 7

The diagram below shows a simplified model and land-use zones of a city in South Africa.

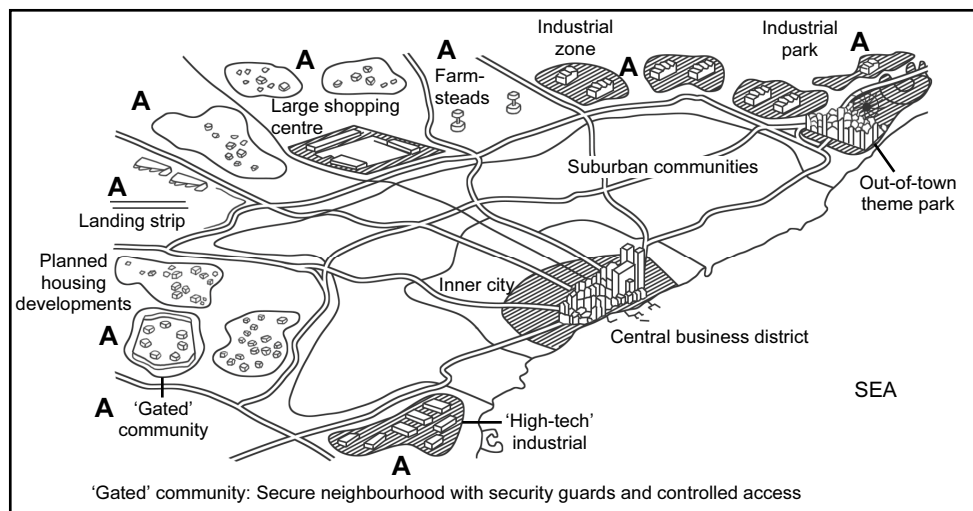


[Adapted from <http://people.uwec.edu/ivogeler/Travel/Southern%20Africa/aparth3.gif>]

- 7.1 Name land-use zone **A**. (1 × 1) (1)
- 7.2 Give a possible reason why the transition zone (**B**) doesn't fully enclose zone **A**. (1 × 2) (2)
- 7.3 Why is land-use zone **D** likely to be a low-income residential area? (1 × 2) (2)
- 7.4 State ONE factor that would have promoted the location of shopping centre **C**. (1 × 2) (2)
- 7.5 Write a paragraph of approximately EIGHT lines in which you discuss the negative factors in land-use zone A that resulted in the relocation of businesses to **C** and its surrounding area. (4 × 2) (8)

QUESTION 8

The diagram below shows the rural-urban fringe marked as **A**.

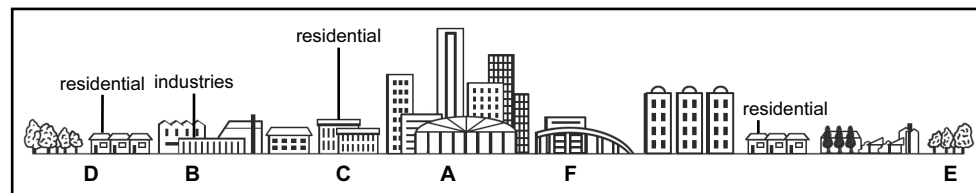


[Adapted from <https://newellta.weebly.com/urban-models.html>]

- 8.1 What is the *rural-urban fringe*? (1 × 1) (1)
- 8.2 State TWO urban land uses that are evident in the rural-urban fringe (**A**). (2 × 1) (2)
- 8.3 Give TWO reasons why the rural-urban fringe is becoming more urban in nature. (2 × 2) (4)
- 8.4 Why is the rural-urban fringe an attractive location for the gated community (secure neighbourhood with security guards and controlled access)? (2 × 2) (4)
- 8.5 The demand for housing is growing rapidly and developers are looking at the rural-urban fringe as a solution for the shortage of building space. Suggest TWO possible objections to planned housing developments in the rural-urban fringe. (2 × 2) (4)

QUESTION 9

Refer to the diagram below which shows the urban profile of a city.



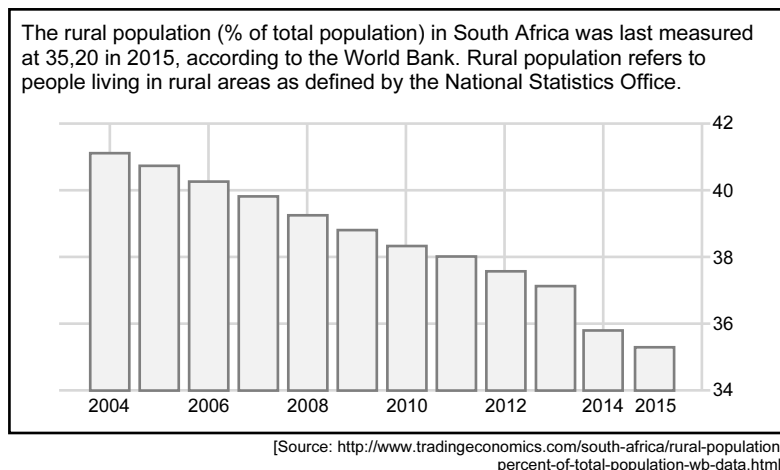
[Adapted from www.learnmindset.co.za]

- 9.1 Name land-use zone **A**.
- 9.2 Name land-use zone **F**.
- 9.3 Which land-use zone occupies the most space?
- 9.4 Is industrial area **B** a light or heavy industrial zone?
- 9.5 Which ONE of the two residential areas (**C** or **D**) is most likely the high-income area?
- 9.6 Identify land-use zone **E**.
- 9.7 Which land-use zone has the highest land value? (7 × 1) (7)



QUESTION 10

Study the following graph which shows the trend of rural population in South Africa from 2004 to 2015.



- 10.1 Comment on the trend from 2004 to 2015 in the graph regarding people living in rural areas in South Africa. (1 × 1) (1)
- 10.2 What percentage of South Africans lived in rural areas in 2015? (1 × 1) (1)
- 10.3 Give a projected percentage for the South African rural population in 2018. (1 × 2) (2)
- 10.4 What impact will the trend in Question 10.1 have on rural areas in the future? (2 × 2) (4)
- 10.5 If the trend in Question 10.1 continues, South Africa might head for food insecurity in the near future. In a paragraph of approximately EIGHT lines, outline sustainable measures to ensure continued food security. (4 × 2) (8)

QUESTION 11

Refer to the following extract based on urban blight, which is an urban issue related to rapid urbanisation.

URBAN RENEWAL PROGRAMME TO FIGHT URBAN BLIGHT ANGERS WOODSTOCK RESIDENTS

The deadline for Bromwell Street residents in Woodstock, Cape Town, to leave their homes has been extended. One of the residents says urban renewal programmes are destroying their lives in Woodstock and Salt River.

The Woodstock Hub gained possession of 120 - 28 Bromwell Street in 2013 to upgrade the buildings. The director of the Woodstock Hub says these properties were supposed to be vacated. Three years later the residents say they have nowhere to go, and blame the urban renewal project and the government for their predicament.

Western Cape MEC of Human Settlements says he has offered the families housing in Delft, but they didn't want to take it. The residents say they don't want to be forced to move so far out of the city into a community that they are not familiar with.

[Adapted from <http://www2.mcdaniel.edu/Biology/ESP/cities/urbanquestions.html>]

- 11.1 What do you understand by the term *urban blight*? (1 × 1) (1)
- 11.2 State ONE cause of urban blight. (1 × 1) (1)
- 11.3 Why have the inhabitants of 120 - 128 Bromwell Street not vacated (left) their homes yet? (1 × 2) (2)
- 11.4 Why do residents feel that urban renewal of the Woodstock Hub is destroying their lives? (1 × 2) (2)
- 11.5 Give TWO reasons why the transition zone requires urban renewal. (2 × 2) (4)
- 11.6 Explain why urban renewal will change 120 - 128 Bromwell Street from a low- to a middle- or a high-income residential area. (2 × 2) (4)

QUESTION 12

Study the diagrams below showing urban sprawl in an urban settlement from 1980 to 2020.



[Source: Unknown]

- 12.1 Define the term *urban sprawl*. (1 × 1) (1)
- 12.2 Describe the effect of urban sprawl on housing density in this urban settlement. (1 × 1) (1)
- 12.3 Give a possible reason why area **A** was not used for urban development in 1980. (1 × 2) (2)
- 12.4 (a) Which street pattern would be most suitable for area **A** in the diagram for 2020? (1 × 2) (2)
(b) Give ONE reason for your answer to Question 12.4(a). (1 × 2) (2)
- 12.5 In a paragraph of approximately EIGHT lines, evaluate the effect that urban sprawl will have on the natural environment at **A** in 2020. (4 × 2) (8)

QUESTION 13

Refer to the following extract on rural-urban migration.

HOPE

Susanne Melda, 26 November 2012

Rural-urban migration is believed to affect various dimensions of migrants' well-being. Desires, such as the opportunity to improve the standard of living and better services, are not always met.

The process of migration is often undertaken with an aspiration (desire) of improved opportunities for socio-economic advancement. However, it does not always entail improvement of living standard and poverty eradication. Rural migrants settling in big cities are the most vulnerable and may experience detrimental (unsafe) living conditions.

[Adapted from www.migratingoutofpoverty.org]

- 13.1 What is *rural-urban migration*? (1 × 1) (1)
- 13.2 The extract implies 'hope' from rural-urban migration. What are the migrants expecting in the urban areas? (1 × 2) (2)
- 13.3 Explain why rural-urban migration does not always lead to an improvement in the standard of living of rural migrants. (2 × 2) (4)
- 13.4 In a paragraph of approximately EIGHT lines, evaluate the negative impact of rural-urban migration on cities. (4 × 2) (8)



4: ECONOMIC GEOGRAPHY OF SOUTH AFRICA

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UNIT 1

THE STRUCTURE OF THE ECONOMY

The economy can be divided into four sectors: the **primary sector**, **secondary sector**, **tertiary sector** and **quaternary sector**.

Economic sectors

Primary activities

- ▶ All the economic activities in which products come directly from nature.
- ▶ For example: mining, fishing, forestry, agriculture (farming), hunting, quarrying.

Secondary activities

- ▶ Raw materials are processed or manufactured into products which are more useful, e.g. building and construction, metal-working, food production.

Tertiary activities

- ▶ The provision of services.
- ▶ No tangible products, e.g. health, education, entertainment, recreation, law and order, financial services, retailing, goods transport, garbage removal.

Quaternary activities

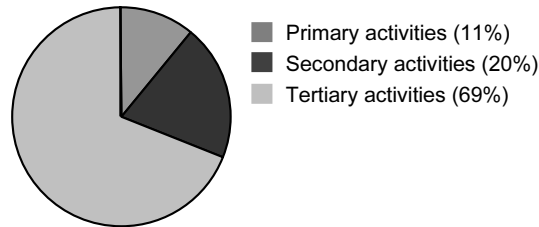
- ▶ Associated with the IT sector, and linked to processing and distribution of knowledge and information, e.g. information technology services, research and management (services rendered by professionals).

GDP (Gross Domestic Product)

total value of all goods and services produced in a country in one year



Contribution of economic sectors to the SA economy



Contribution to South Africa's GDP: 2017

[Source: Statistics SA]

Primary activities

- ▶ Mining and agriculture are the two most important primary contributors.
- ▶ Mining has decreased substantially, but international demand for raw materials makes it an important commodity.
- ▶ Agriculture is under strain due to the fluctuating market and rand-value; rising production costs; low income due to weather inconsistencies; and competitive international market.
- ▶ Fishing and forestry activities contribute much less.
- ▶ Approximately 11% of all workers are employed in primary activities.

Secondary activities

- ▶ The metal and engineering industries and construction are the most important contributors, e.g. the motor industry.
- ▶ Approximately 24% of all workers are employed in secondary activities.

Tertiary activities

- ▶ Finance, transport, communications, tourism, real estate and government are the major contributors to the GDP.
- ▶ Approximately 65% of all workers are employed in tertiary activities.

UNIT 2

AGRICULTURE

- ▶ Agriculture is a primary economic activity.
- ▶ Land is cultivated for crop production and livestock is farmed for food production.
- ▶ Food production has changed as a result of mechanisation, improved irrigation, the use of chemicals and fertilizers, hybridisation and genetically modified crops.
- ▶ These new methods enhance **food security** and limit the risks and vulnerability experienced in this economic sector.

Contribution of agriculture to the South African economy

- ▶ Agriculture only contributes 3% to the GDP, compared to the larger contribution of the secondary and tertiary sectors.
- ▶ Agriculture supports the development of services in the secondary and tertiary sectors because it requires transport and delivers raw materials for manufacturing.
- ▶ South Africa is self-sufficient in most basic food crops, and also contributes to the GDP by exporting some of these crops.
- ▶ Agriculture provides employment.



The role of small-scale farmers and large-scale farmers



Commercial farming	farming for profit where food is produced on a large scale
Subsistence farming	takes place on a small scale and agricultural products are produced to be consumed by family and community

Main products produced

South Africa has a wide range of climates. This makes it possible to farm a range of crops and livestock.

► Cattle

- In 2016, South Africa ranked 15th of the world total of red meat exports.
- The South African beef industry has seen enormous growth in exports.
- South Africa exports frozen beef to other parts of Africa, the Far East and Middle East (United Arab Emirates).
- Problems include outbreaks of Foot and Mouth Disease and droughts that negatively affect grazing land.

► Maize

- Maize is South Africa's most important crop for both the home market and the export market.
- It is grown mainly in areas where there is summer rainfall – North-West, Mpumalanga, Free State and KwaZulu-Natal.
- Maize is an important food for many people depending on subsistence farming and also used as a livestock feed.
- It earns valuable foreign exchange.

► Sugar cane

- Sugar cane is grown in the wetter parts of KwaZulu-Natal and the southern Mpumalanga Lowveld.
- It is a major export crop.

Home market

- South Africa has increased its food production in the last few years.
- Most grains, vegetables and seasonal fruit are grown for local consumption.
- Meat and poultry products are also produced for the home market.



Export market

- South Africa has increased its export of agricultural products and is a leading exporter of deciduous fruits, avocados, grapefruit, maize and ostrich products.
- Processed agricultural products such as wine and rooibos tea bring in valuable foreign exchange.

Factors that favour and hinder agriculture in South Africa

Factors favouring agriculture in South Africa

► Climate

- South Africa has a range of climates and natural vegetation. This makes it possible to farm a range of crops and livestock.
- The wetter and warmer, eastern parts of South Africa support the farming of sugar cane and subtropical fruit. The winter rainfall areas in the southwestern parts support deciduous fruit and wheat farming. Livestock farming is more suited to the drier northwestern parts.
- Most arable areas are frost-free and this supports a longer growing season.

► Relief

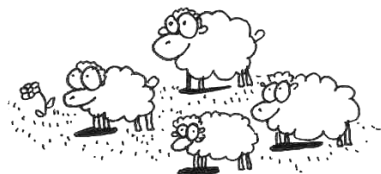
- Much of the country is flat or has an undulating landscape with low hills.
- This feature supports extensive crop farming (wheat and maize) and livestock rearing (sheep and cattle).
- Rivers provide irrigation water in the drier western parts of the country.

► Research

- New drought-resistant and pest-resistant hybrid seeds are used, producing higher yields.
- Climate research can predict hazards more accurately (droughts, floods, hailstorms) and disaster management strategies are more effective.

Factors hindering agriculture in South Africa

- Only a small portion of arable land is suitable for crop farming.
- In many parts of South Africa the soil is very thin and, due to over-cultivation and overgrazing, the damaged soil is less fertile. Erosion (water and wind) is a serious problem.
- Farming methods are often poor. Poverty makes it difficult for farmers to buy machinery and introduce modern methods. Many farmers cannot afford fertilisers and pest control.
- Many areas are too densely populated for commercial farms to develop. Too many people have to share the land.
- Some areas have poor transport networks. Training and education in new farming practices are neglected.



Food security/insecurity

Food security

food security exists when all people have enough food in order to sustain a healthy life



Importance of food security in South Africa

- At present, South Africa produces enough food. However, the population is increasing, which means that food consumption is also increasing. At the same time the production of some basic foods is decreasing.
- Agricultural products are mainly exported to the countries of the European Union (EU) and Southern African countries. In times of shortfalls due to droughts, South Africa can afford to supplement food by importing it.
- There are some urban and rural areas where people do not have enough food to eat, and so food insecurity/shortage exists. A national nutrition programme has been introduced in primary schools to feed learners.
- Most of the poorest households are in the rural areas where subsistence farmers cannot produce enough food for their own consumption.

Factors influencing food security in South Africa

► Droughts

- Lack of rainfall results in a decline in food production and raises the price of food.



► Economic problems

- Money that should go towards job creation and agricultural development has often been mismanaged or stolen. This has resulted in fewer job opportunities.

► Poverty

- People do not have enough money to buy food.

► Population growth

- Land is over-utilised and there is less land to grow food on.

► HIV and Aids

UNIT

3

MINING

Contribution of mining to the South African economy

- ▶ The mining sector's share of the South African economy is according to 2017 statistics estimated to be 8% of the GDP (Gross Domestic Product).
- ▶ Mining also brings additional economic development as it has resulted in other industries, transport links and services.
- ▶ Mining earns more than 45% of South Africa's foreign exchange. Minerals are exported either in their raw state or after they have been processed.



Beneficiation

minerals that are processed into a product of higher value, e.g. iron ore into steel.

- ▶ Mines are a major source of employment.
- ▶ Mining companies contribute billions in taxes to the economy.
- ▶ Mining activities have attracted huge foreign investment to South Africa.
- ▶ About 77% of South Africa's energy needs are directly derived from coal that is mined in South Africa.

Significance of mining to development in South Africa

- ▶ The discovery of diamonds and gold resulted in the development of South Africa's infrastructure, e.g. railways.
- ▶ Mining led to the opening of universities and educational institutions as there was a need for training in geology, engineering and other fields.
- ▶ Mining resulted in huge investment in South Africa to develop new mines and related industries.



- ▶ Link industries were developed to supply products to the mines.



Link industries

industries that supply materials or equipment to another industry or which depends on another industry for its own processes

- ▶ Mines and link industries provide employment for many people.
- ▶ The export of minerals has resulted in valuable foreign exchange for South Africa.

Main products produced

▶ Coal

- ▶ South Africa is the 6th largest coal-exporting nation in the world.
- ▶ Coal makes up 6% of all South Africa's exports and about 77% of South Africa's energy needs are directly derived from coal.
- ▶ Richards Bay is South Africa's major coal export harbour.
- ▶ Most of South Africa's coal (90%) is mined in Mpumalanga, close to Gauteng.
- ▶ Electricity is generated close to the coal mines and the consumers. Coal is also mined in Limpopo, KwaZulu-Natal and Free State.
- ▶ Coal is also supplied to SASOL which produces oil from coal at Sasolburg and Secunda.
- ▶ Coal production contributes to South Africa's economy by providing employment and foreign exchange.
- ▶ Pollution caused by mines and burning coal in power stations is a serious problem.
- ▶ Mpumalanga province has one of the highest air pollution levels in the world.

► Gold

- The discovery of gold in the late 19th century led to the development of the city of Johannesburg.
- For many years, South Africa was the world's biggest gold producer.
- The Witwatersrand basin is one of the world's largest gold resources. However the gold price and gold production has declined. This has resulted in a decline in employment in the gold sector. Despite this, gold mining activities are still a large employer.

► Platinum

- 90% of the world's known platinum reserves are in South Africa.
- South Africa's platinum reserves are found in the Bushveld Complex. This is a massive area of igneous rock that extends near Rustenburg to Mashishing (Lydenburg).
- Platinum is used in catalytic converters, laboratory equipment, electrical contacts and electrodes, platinum resistance thermometers, dentistry equipment and jewellery.

Factors that favour and hinder mining in South Africa

Factors favouring mining in South Africa

- South Africa's mineral resources are estimated to be the largest in the world. South Africa also has a wide range of different minerals.
- The mineral seams are often thick and near to the surface so are more easily mined.
- The low geothermal gradient in South African mines reduces the cost of cooling the air that is pumped down into the mines.

Geothermal gradient

the rate at which the rock temperature increases with increasing depth below the surface



- South Africa has a large source of unskilled labour.
- Many countries have invested capital in South African mines.
- South Africa has a developed infrastructure – railways, roads, water and electricity.
- South Africa's huge coal resources are used to make electricity. This helps to keep costs lower.

Factors hindering mining in South Africa

- Mining of both gold and platinum is labour intensive and expensive.
- Cooling underground requires a great deal of energy which has become costly and Eskom is struggling to keep up with the demand.
- Labour unrest and violent protests combined with rumours of possible nationalisation of mines have been a deterrent for many foreign investors.
- Fluctuations in the rand exchange rates have had serious effects on the gold mines and some have had to close when prices fell too low.
- Many of South Africa's mineral deposits are located far inland. This means that transport costs are high.
- The mining industry uses large amounts of water. In addition, mining produces huge amounts of waste and contaminated water which threaten the environment and water supplies.
- Huge costs are involved in minimising the negative effects of mining and in rehabilitating old mine sites.



UNIT
4

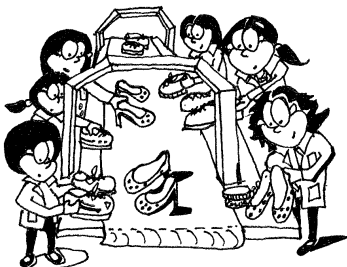
SECONDARY AND TERTIARY SECTORS

Contribution of secondary activities to the South African economy

- ▶ The secondary and tertiary sectors of South Africa's economy are both larger than the primary sector in terms of their contribution to the gross domestic product (GDP).
- ▶ In 2017 the secondary sector contributed 20% to the GDP and the tertiary sector contributed 69%.



Secondary sector	includes manufacturing, construction and utilities (supply of water, electricity and gas)
Tertiary sector	includes a great range of occupations; people who work in the tertiary sector provide a service of some sort; as the South African economy matures, the tertiary sector continues to grow



Types of industries

Heavy industry

- ▶ uses large quantities of raw materials
- ▶ may emit much waste and pollution
- ▶ requires mass transport
- ▶ requires large areas – usually located on the urban edges
- ▶ e.g. steel plants, petro chemicals

Light industry

- ▶ manufactures smaller products
- ▶ does not produce pollution
- ▶ located in industrial areas within the city
- ▶ e.g. clothing, packaged food



Raw material orientated

- ▶ located close to the source of raw materials
- ▶ produces perishable goods
- ▶ e.g. butter and cheese near dairy farms, wine near vineyards

Market orientated

- ▶ industries that manufacture bulky or perishable products
- ▶ factories are placed close to where the buyers are, e.g. bakeries making bread
- ▶ If the industry produces heavy or bulky products, e.g. furniture or if the product is expensive to transport, e.g. big machines, then the factory needs to be located close to the market.

Footloose industries

- ▶ industries that are not tied to any specific location
- ▶ e.g. upholstery factory

Ubiquitous industries

- ▶ industries that can be found anywhere
- ▶ e.g. bakeries, butchers

Bridge industries (break-of-bulk points)

- ▶ Set up where cargo is transferred from one mode of transport to another, e.g. at a port.
- ▶ Motor car manufacturers Ford and General Motors in Port Elizabeth - established where necessary components arrive by ship.

Factors favouring industrial development in South Africa

Raw materials

- ▶ South Africa mines a wide range of minerals. Many of these are used in heavy industry.
- ▶ Agriculture supplies raw materials for food manufacturing.

Labour supply

- ▶ Many unskilled workers.
- ▶ Need for more skilled workers.

Water supply

- ▶ Most industries need water to operate. South Africa has numerous dams and also inter-basin transfer schemes.

Energy supply

- ▶ South Africa has large coal reserves. There is an abundance of coal in Mpumalanga which provides thermal electricity and has helped to keep power costs lower.

Transport

- ▶ South Africa has a good infrastructure – rail, road and flight networks, as well as harbours.
- ▶ Allows for transport of raw materials and finished products.

Political intervention

- ▶ Since the late 1990s the government has started programmes to help manufacturers to set up new factories.
- ▶ E.g. IDZs (Industrial Development Zones)
SDIs (Spatial Development Initiatives)

Competition

- ▶ South Africa markets are small and competition from the large markets of Europe and Asia (especially China) has limited the development of industries in South Africa.
- ▶ South African businesses struggle to compete with the cheaper-priced Chinese goods.

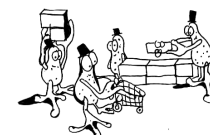
Trade

- ▶ South Africa is well located and accessible to trade in local, regional and foreign markets.
- ▶ Trade brings in capital which can be used to expand businesses and lead to increased employment.

Factors hindering industrial development in South Africa

Over concentration

- ▶ Industries in South Africa are over-concentrated in four core areas:
 - PWV (Gauteng)
 - Durban-Pinetown (eThekweni metropole)
 - Port Elizabeth-Uitenhage (Nelson Mandela metropole)
 - Southwestern Cape
- ▶ Since 1994, a new industrial policy in South Africa has aimed to facilitate industrial activity in other areas of the country.



Transport

- ▶ An efficient transport infrastructure is necessary for bringing in raw materials and distributing manufactured products.
- ▶ South Africa has a good network of roads, harbours and railways to support industry however there are several challenges: the rail system is not functioning efficiently and as a result roads are used as the main means of transport which puts a strain on the road infrastructure.

Air pollution

- ▶ Air pollution is a major problem in South Africa.
- ▶ The main sources of industrial air pollution are thermal power stations, smelters, cement and chemical factories.

Labour supply

- ▶ Industries that produce specialised goods tend to locate where skilled labour is concentrated – this is often close to major cities.

Water supply

- ▶ Water is needed by most industries.
- ▶ Those that use a lot of water e.g. steel production and fruit processing need to be located where there is a good supply of water.

Raw materials

- ▶ South Africa has large quantities of minerals and agricultural products.
- ▶ Some agricultural products such as fruit, are perishable so industries need to be located near to where they are grown.

Political interference

- ▶ Government has a major impact on the location of factories.
- ▶ The introduction of Industrial Development Zones (IDZs) and Spatial Development Initiatives (SDIs) has resulted in industries developing in certain areas.

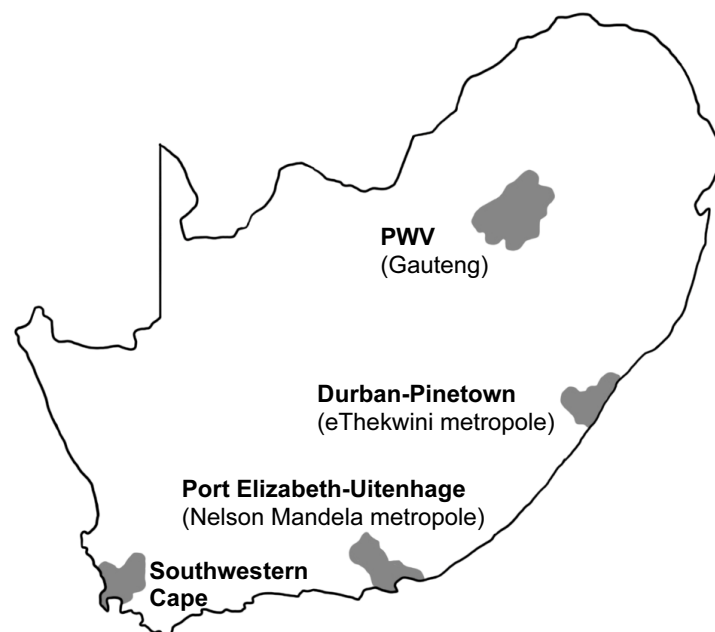
Competition

- ▶ South African markets are small in comparison to those of Europe and Asia.
- ▶ The competition from China has resulted in the decline of many industries in South Africa e.g. clothing.
- ▶ South African companies cannot compete with the goods sold at lower prices. This leads to increased unemployment in South Africa.

Trade

- ▶ South Africa urgently needs to develop trade with overseas markets. Government should encourage and incentivise companies to enable them to do this.

Four core industrial areas of South Africa



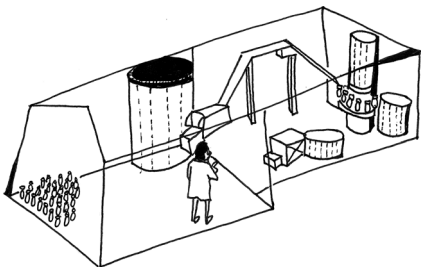
PWV (GAUTENG) (Tshwane-Witwatersrand-Vaal complex)

Main industrial activities

- ▶ Metals, iron and steel plants (Vanderbijlpark, Vereeniging)
- ▶ Motor vehicles (BMW, Nissan)
- ▶ Chemicals (explosives)
- ▶ Petrochemicals (SASOL at Sasolburg and Secunda)
- ▶ Machinery

Factors influencing location

- ▶ Availability of water - Vaal River. Inter basin transfer from the Tugela-Vaal Project and the Lesotho Highlands Water Project
- ▶ Gold provided the initial stimulus
- ▶ Well-developed transport network
- ▶ Raw materials available – minerals and agricultural products
- ▶ Availability of labour force – skilled and unskilled
- ▶ Energy resources available – mines provide coal to the thermal power stations
- ▶ Good and plentiful agricultural land
- ▶ Large market – fast-growing population provided a market for a huge range of industries.



DURBAN-PINETOWN (eThekweni metropolitan region)

Main industries

- ▶ Oil refining (making petrol from crude oil)
- ▶ Sugar processing (Hulett's)
- ▶ Chemicals
- ▶ Paint
- ▶ Textiles
- ▶ Motor vehicles (Toyota)
- ▶ Shoes (Bata)

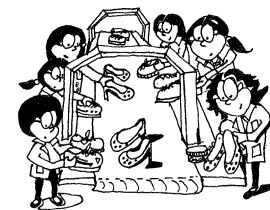
Factors influencing location

- ▶ Durban is the closest South African port to the oil-producing countries of the Middle East
- ▶ High rainfall region, so there is a good water supply
- ▶ Location of Durban harbour close to large markets in Gauteng
- ▶ Large local market
- ▶ Unskilled and skilled labour available
- ▶ Linked to Gauteng by road and rail

PORT ELIZABETH-UITENHAGE (Nelson Mandela metropolitan region)

Main industries

- ▶ Motor vehicle assembly plants (Volkswagen, Mercedes Benz, Delta, General Motors and Ford)
- ▶ Supporting industries (motor parts, tyres)
- ▶ Textile (wool)
- ▶ Leather (shoes)
- ▶ Fruit canning
- ▶ Salt works



Factors influencing location

- ▶ Water available – Orange River Project
- ▶ Port Elizabeth harbour
- ▶ Plenty of labour (although mainly unskilled)
- ▶ Equalised rail tariffs (costs are the same as the rest of the country)
- ▶ Central location to markets
- ▶ Industrial Development Zone: Coega, near Port Elizabeth

SOUTHWESTERN CAPE

Main industries

- ▶ Food processing (fish, fruit)
- ▶ Clothing and footwear
- ▶ Oil refining (Milnerton)
- ▶ Link industries (printing and packaging)
- ▶ Wine making

Factors influencing location

- ▶ Enough water from dams
- ▶ Raw materials available, e.g. fruit, fish, wheat, vegetables, dairy, chickens
- ▶ Cape Town harbour, as well as good transport links
- ▶ Foreign tourist market and local market
- ▶ Higher level of education than national average and specialised skills, e.g. clothing industry
- ▶ Historical factors – Cape Town (first city in SA); parliament
- ▶ Energy – negative factor; far from the coal fields so high cost of electricity



Strategies for industrial development in South Africa

Overview of apartheid and post-apartheid industrial development strategies

▶ The Good Hope Plan (apartheid)

- ▶ Introduced in 1982. Focused on the Basic Needs Philosophy.
- ▶ To provide basic needs, food, clean drinking water, proper sanitation, housing, education, health care and employment in order for people to be productive and live life with dignity.

▶ The Reconstruction and Development Programme (RDP) (post-apartheid)

- ▶ The aim was to eradicate the affects of apartheid and improve the quality of life of all South Africans by providing them with basic needs, e.g. housing, electricity and clean water.

▶ Growth, Employment and Redistribution (GEAR) (post-apartheid)

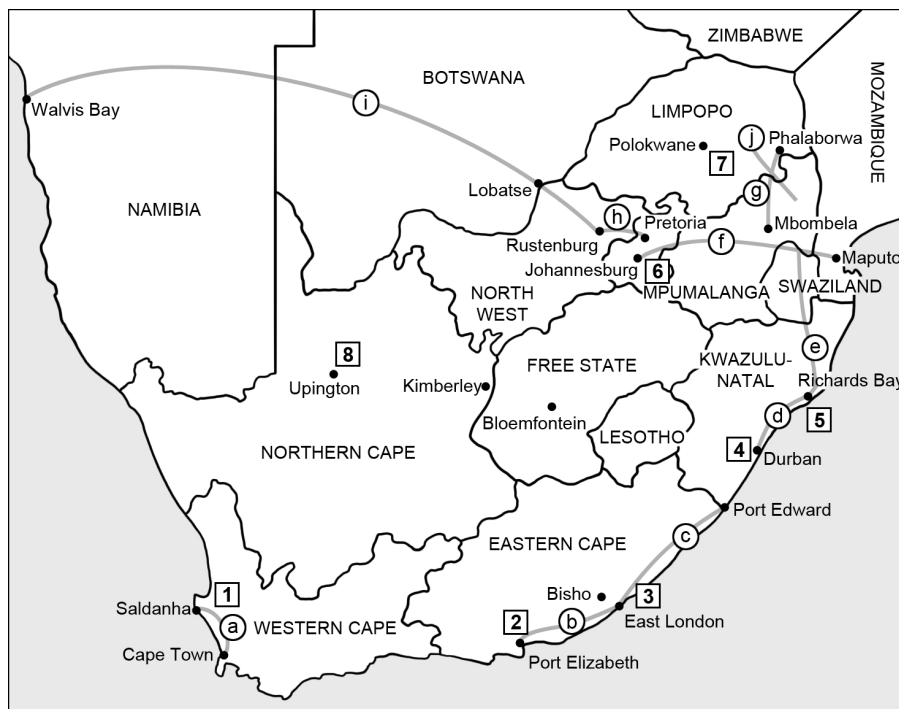
- ▶ Government introduced a macro-economic policy framework, called the Growth, Employment and Redistribution (GEAR) strategy in 1996 to stimulate faster economic growth.
- ▶ GEAR was only moderately successful in achieving some of its goals but was hailed by some as laying an important foundation for future economic progress.
- ▶ It succeeded in attracting foreign investment and in increasing demand for South African products.

Concept and distribution of Industrial Development Zones (IDZ)

- ▶ In 1996 the government introduced a new development plan. It was based on two initiatives:
 - ▶ **Spatial Development Initiatives (SDIs)**
 - ▶ **Industrial Development Zones (IDZs)** which are cores within the SDIs.

Industrial Development Zones (IDZs)

- ▶ Eight IDZs were selected for advanced development. These IDZs were either at ports or near to airports.
- ▶ The main objective of an IDZ is to develop infrastructure and services of certain areas and to promote investment there.
- ▶ By 2013, four IDZs were operating: Richards Bay, East London, Coega (near Port Elizabeth) and Saldanha Bay.
- ▶ The government aims to make IDZs more attractive to foreign investors by offering tax incentives.
- ▶ The government is revising the concept of IDZs into a new strategy of Special Economic Zones (SEZs) which focus on Foreign Direct Investment (FDI).



Industrial Development Zones (IDZs) and Spatial Development Initiatives (SDIs) of South Africa

INDUSTRIAL DEVELOPMENT ZONES	
1 Saldanha Bay	5 Richards Bay
2 Coega, Port Elizabeth	6 Johannesburg
3 West Bank, East London	7 Polokwane
4 Durban	8 Upington

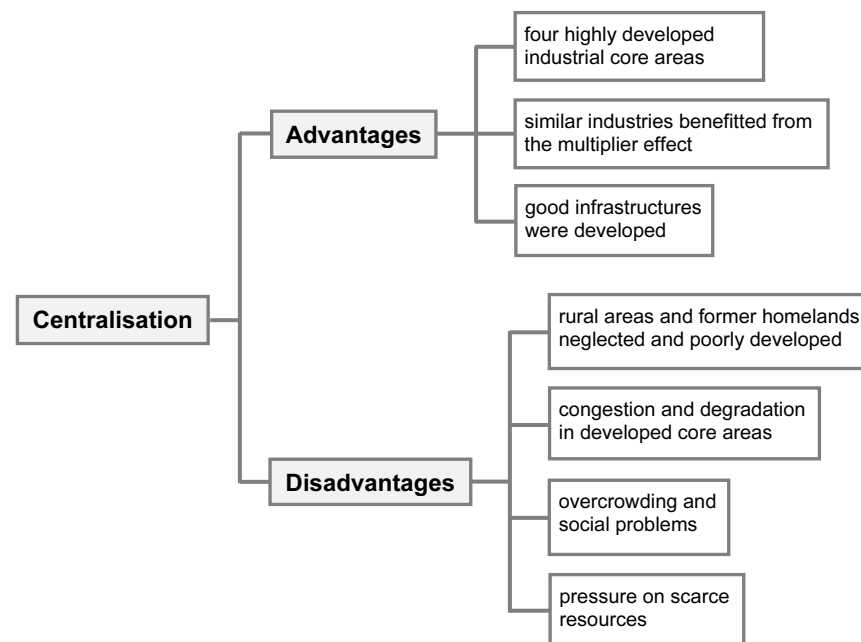
SPATIAL DEVELOPMENT INITIATIVES	
a Saldanha	f Maputo Development Corridor
b Fish River	g Phalaborwa Secondary Corridor
c Wild Coast	h Rustenburg
d KwaZulu-Natal	i Trans-Kalahari Transport Corridor
e Lebombo	j Phalaborwa

Spatial Development Initiatives (SDIs)

- ▶ A Spatial Development Initiative is a programme to initiate and support a series of development corridors stretching across parts of South Africa and also into neighbouring countries.
- ▶ The aim of SDIs is:
 - › to develop and improve existing transport infrastructures
 - › to initiate and support economic activities along transport corridors
 - › to create an attractive environment for private sector investment
- ▶ e.g. Maputo Development Corridor – connects the economic centre of Gauteng with the harbour of Maputo, Mozambique.

Issues related to industrial centralization and decentralisation

South Africa's wealth and industry is concentrated in the **four core industrial areas**. As these areas develop and get richer, the rest of the country (called the periphery) becomes less developed and poorer. The advantages and disadvantages of centralisation are summarised in the diagram below:



Advantages and disadvantages of centralisation

Contribution of tertiary activities to the South African economy

- ▶ Tertiary activities typically refers to the service sector.
- ▶ Examples include transportation, health care, food service, retail sales, advertising, entertainment, tourism, banking, law and education.

The role of international trade in economic development

- ▶ International trade plays an important role in increasing the production of any country.
- ▶ In countries where the home market is limited, it is necessary to sell products in other countries.
- ▶ Foreign trade encourages businesses to increase the investment to produce more goods.

Role of transport in economic development

- ▶ Transport improves overall accessibility.
- ▶ There is a relation between the quantity and quality of transport infrastructure and the level of economic development.



UNIT 5

THE INFORMAL SECTOR

- ▶ At present South Africa faces the problem of growing unemployment. As a result, people create their own employment in the informal sector, the so-called 'hidden part' of the economy.



Informal sector	consists of self-employed people; people work for themselves from their own homes or as vendors on the streets, generally without a license or a business permit
Formal sector	all jobs with normal hours and regular wages and are recognised as income sources on which income taxes must be paid

- ▶ Informal trading generally refers to market traders, hawkers or street vendors, spazas and house shops. These traders operate in city streets, and in high-density areas such as townships and informal housing settlements.
- ▶ Generally, the following goods and services are provided:
 - ▶ Selling of fruit, vegetables, clothing, handcrafted goods, cheap imported goods (sunglasses, shoes, belts, handbags), traditional herbs
 - ▶ Pavement hair salons, car guards, car washers or any other casual labour



Characteristics of informal sector employment

- ▶ Lack of access to financial services such as credit.
- ▶ Limited business skills.
- ▶ Self-employed.
- ▶ Inadequate or no links with supplies from formal businesses.
- ▶ Very limited access to infrastructure and basic services such as water, electricity and rubbish removal.
- ▶ Limited access to government regulations on how space can be acquired and the issuing of trade licensing.
- ▶ Unwillingness to undergo formal trading as they will lose out on trading hours.
- ▶ Incomes are low and uncertain and long working hours.
- ▶ Profit margins are low.
- ▶ Mostly unskilled or semi-skilled workers.
- ▶ Small-scale services provided mostly on the streets.
- ▶ Some goods made from recycled materials.
- ▶ Workers have no protection by trade unions.
- ▶ Many problems: litter; unhygienic environments; congested pavements; petty crime; and urban decay.

Reasons for high informal sector employment in South Africa

- ▶ Inadequate training and low literacy levels mean that many people moving to the cities and towns from the rural areas are not equipped to enter the job market.
- ▶ Urbanisation: new arrivals in towns and cities outnumber the available job opportunities.

Challenges facing South Africa's informal sector

- ▶ In South Africa, the informal economy offers employment to 20% of the employment force.
- ▶ Some 3 million people were employed in the informal sector in 2018.
- ▶ Informal-sector traders lack access to credit.
- ▶ Frequently infringe the city's trading regulations.
- ▶ To develop businesses to the next level, traders need to obtain licenses and undergo training.



Importance/role of the informal sector in the economy

- ▶ The informal sector plays a very important role – it gives opportunities to people who are not employed to earn money through their various skills and businesses.
- ▶ It creates job opportunities, contributes to alleviating poverty and serves as a buffer between employment and unemployment.

Strategies for strengthening the informal sector

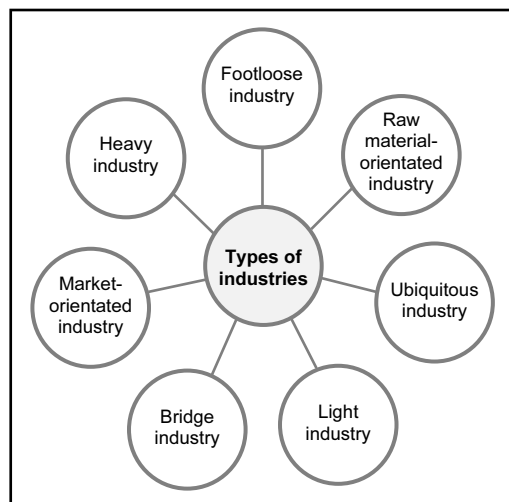
Shortfalls in skills in the informal sector are largely due to low education, unequal access to training, underdeveloped markets and market constraints.

- ▶ Ensure a quality basic education for all.
- ▶ Governments can fund and promote private investment in skills development.
- ▶ Programme to develop business skills.

QUESTIONS ECONOMIC GEOGRAPHY OF SOUTH AFRICA

QUESTION 1

Refer to the diagram alongside and match the types of industries in the diagram with the statements below.



[Source: Examiner's own graphic]

- 1.1 Industries that produce perishable goods
- 1.2 Industries that can be located anywhere and are not restricted by the location of markets or raw materials
- 1.3 Industries that can be located anywhere without an effect from factors such as resources or transport
- 1.4 Industries that process bulky raw materials
- 1.5 Industries located on the outskirts of the built-up areas because of noise and air pollution
- 1.6 Industries located between the source of the raw material and the market (customers)
- 1.7 Industries that occupy small spaces and can be located in the city centre

(7 × 1) (7)

QUESTION 2

Choose a term in COLUMN B that matches the description in COLUMN A. Write only the letter (A - H) next to the question number (2.1 - 2.7), for example 2.8 J.

COLUMN A	COLUMN B
2.1 Associated with scientific methods of farming and investments in land and machinery	A urban agriculture
2.2 Type of farming where every available piece of land is cultivated	B labour intensive
2.3 Crops grown in residential areas	C large-scale farming
2.4 Farms that depend heavily on manual labour	D monoculture
2.5 Products manufactured for sale to other countries	E intensive farming
2.6 Products sold within South Africa	F export market
2.7 Farming that grows one product (crop)	G home market
	H import market

(7 × 1) (7)

QUESTION 3

Refer to the table below showing contributions to South Africa's GDP.

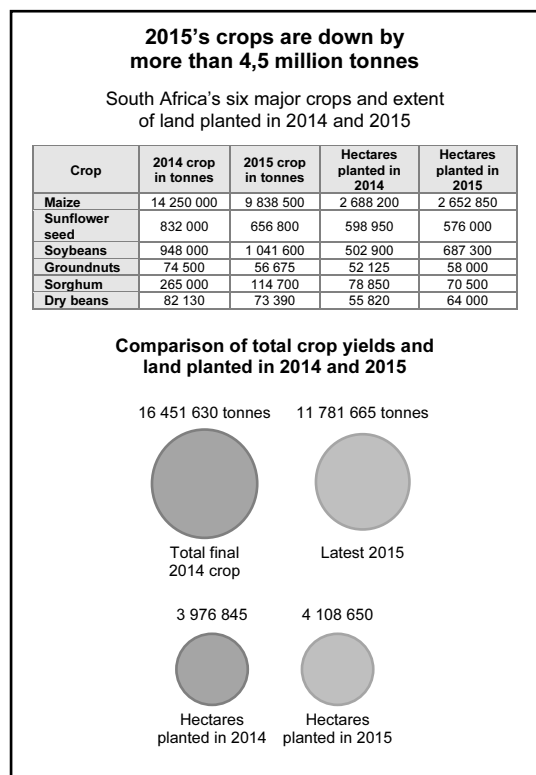
ECONOMIC ACTIVITY	CONTRIBUTION
Agriculture, forestry and fishing	2,2%
Mining and quarrying	4,9%
Manufacturing	15,2%
Electricity, gas and water	1,8%
Construction	3%
Finance, real estate and business services	21,5%
General government services	13,7%

[Source: <https://www.brandsouthafrica.com/investments-immigration/economynews/sa-economy-key-sectors>]

- 3.1 Which economic activity in the table contributed the most to South Africa's GDP? (1 × 1) (1)
- 3.2 Which economic sector contributed the most to South Africa's GDP? (1 × 1) (1)
- 3.3 Explain the low contribution of the primary economic sector to the South African economy. (2 × 2) (4)
- 3.4 Why is it important to strengthen the secondary sector in South Africa? (2 × 2) (4)
- 3.5 Account for the low contribution made by electricity, gas and water to the tertiary sector. (2 × 2) (4)

QUESTION 4

Study the diagram below, which shows current trends in the South African agricultural production.



[Source: Mail & Guardian, 4 September 2015]

- 4.1 Which crop in South Africa has shown an increase in production since 2014? (1 × 1) (1)
- 4.2 Name the crop showing the greatest decrease in production from 2014 to 2015. (1 × 1) (1)
- 4.3 State the relationship between crop yields and hectares planted for the period 2014 to 2015. (1 × 2) (2)
- 4.4 Give TWO possible reasons for your answer in Question 4.3. (2 × 2) (4)
- 4.5 In a paragraph of approximately EIGHT lines, suggest measures that can be employed to improve crop production to meet the needs of the growing South African population. (4 × 2) (8)

QUESTION 5

The table below shows South Africa's position on the global food security index.

RANKING OF SOUTH AFRICA IN 2016 COMPARED TO 2012					
COUNTRY	GLOBAL FOOD SECURITY INDEX				GDP US\$ 2016
	2012 Score	2012 Ranking	2016 Score	2016 Ranking	
South Africa	61,7	40	62,9	47	13 481

[Source: Economist Intelligent Unit (EIU) Report, 2016 GFSI Edition]

- 5.1 Describe the change in South Africa's food security index score from 2012 to 2016. (1 × 1) (1)
- 5.2 State the change in South Africa's world ranking in terms of the food security index from 2012 to 2016. (1 × 1) (1)
- 5.3 When is a country considered to be food secure? (1 × 2) (2)
- 5.4 Explain the positive impact of having food security in South Africa. (2 × 2) (4)
- 5.5 Write a paragraph of approximately EIGHT lines in which you analyse the reasons for South Africa's low food security index. (4 × 2) (8)



QUESTION 6

In terms of the contribution of mining to a country's GDP, South Africa is ranked fifth in the world.

- 6.1 Why is mining considered to be a primary activity? (1 × 1) (1)
- 6.2 Which mineral contributes the most to South Africa's GDP? (1 × 1) (1)
- 6.3 Discuss TWO physical factors that promote mining in South Africa. (2 × 2) (4)
- 6.4 Suggest ONE way in which South Africa can address labour issues, in order to improve its world ranking. (1 × 2) (2)
- 6.5 In a paragraph of approximately EIGHT lines, explain the economic importance of mining for infrastructure and industrial development in South Africa. (4 × 2) (8)

QUESTION 7

Read the extract below based on mining in South Africa.

RENEWAL OF THE SA MINING INDUSTRY

Friday 11 September 2015, 18:21

The South African mining and minerals industry has been the basis of the South African economy for more than a century. Mining contributes approximately 17% to the gross domestic product (GDP) of the country, both directly and indirectly.

The South African mining sector faces significant challenges under the current downturn in commodity prices. Platinum, coal, steel and gold markets are affected. The increase in input costs, such as labour and direct and indirect energy-related costs, coupled with lower productivity levels, has impacted negatively on the sector.

While there have been improvements in mining along the way, it is still very reliant on traditional methods of extraction, which are labour-intensive and costly, and have elements of risk to employees' safety and health.

[Adapted from www.csir.gov.za]

- 7.1 Give TWO reasons given in the extract for the decrease in the contribution of mining to the GDP. (2 × 1) (2)

- 7.2 State ONE physical factor that could endanger a miner's life below the surface. (1 × 2) (2)
- 7.3 Discuss TWO possible reasons for the increasing input costs of labour. (2 × 2) (4)
- 7.4 Write a paragraph of approximately EIGHT lines and discuss the direct and indirect contribution of mining to the GDP of South Africa. (4 × 2) (8)

QUESTION 8

Read the extract below on coal mining in South Africa.

COAL MINING IN SOUTH AFRICA

Coal mining in South Africa plays a significant role in the country's economy, as it is responsible for nearly three quarters of Eskom's fuel supply. It also supplies coal to SASOL, who produces around 35% of the country's liquid fuel.

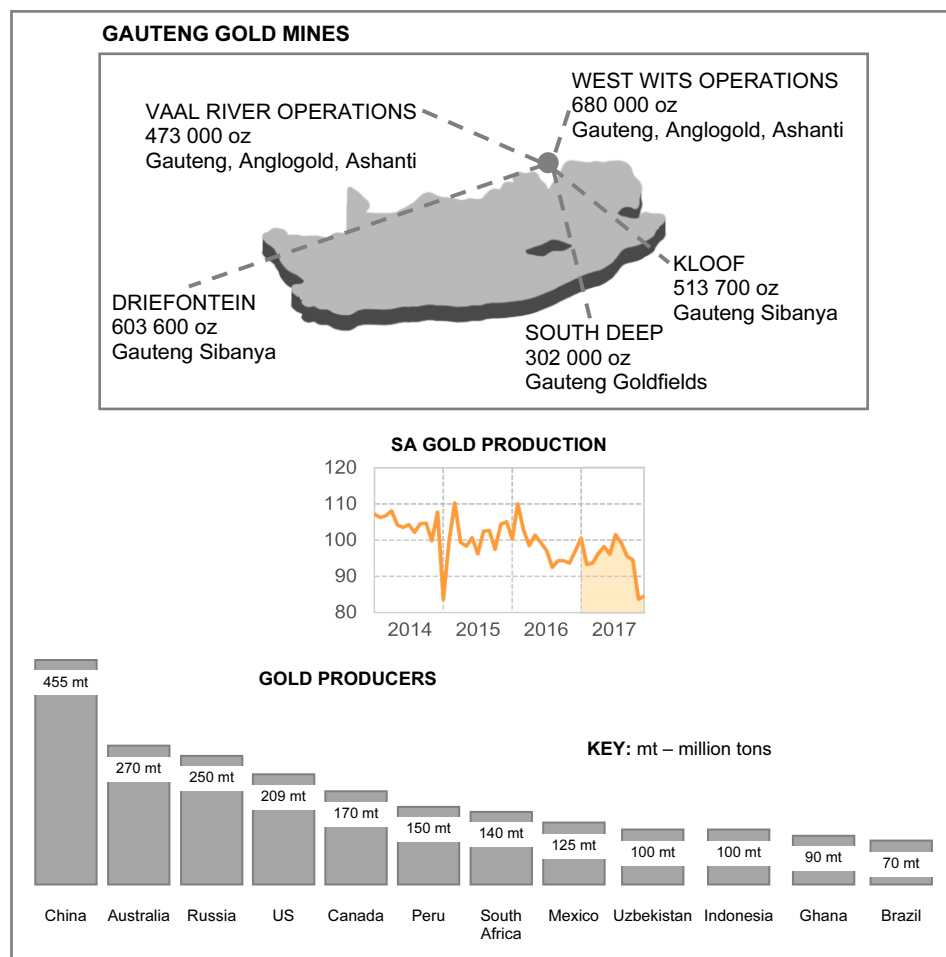
Coal mining in South Africa is centred on the Highveld, with roughly 60% of the country's deposits located in eMalahleni (Witbank) and surrounding areas.

[Source: <http://www.projectsigs.co.za/coal-mining-in-south-africa.htm>]

- 8.1 Name the province in which most of South Africa's coalfields are found. (1 × 1) (1)
- 8.2 Name TWO of South Africa's major industries that are dependent on coal as a raw material. (2 × 1) (2)
- 8.3 State TWO environmental problems resulting from coal mining in South Africa. (2 × 2) (4)
- 8.4 Mining and coal-dependent companies should work together to rectify environmental injustices associated with coal mining. In a paragraph of about EIGHT lines, explain how this can be achieved. (4 × 2) (8)

QUESTION 9

Refer to the diagram and graph below showing statistics on gold mining in January 2017.



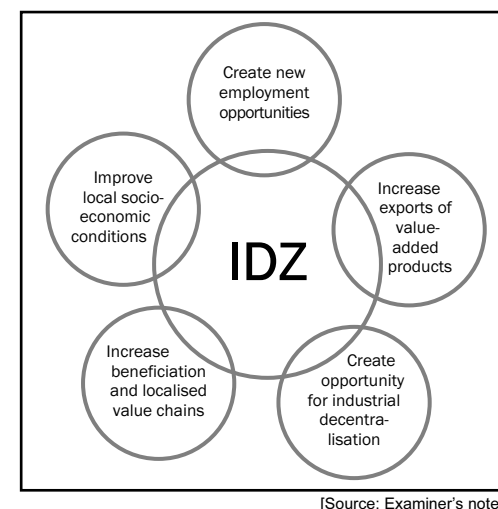
[Adapted from http://www.kitco.com/ind/Media/images/South_Africa.jpeg and http://www.statssa.gov.za/wp-content/uploads/2-18/02/Infographic_v04-1]

- 9.1 Name the province where the most gold is mined in South Africa.
- 9.2 Which gold mine in Gauteng produces the most gold per ounce (oz) in South Africa?
- 9.3 Name the mining company that produced the most gold.
- 9.4 Name the country with the highest production of gold in the world.

- 9.5 What is the ranking of South Africa in terms of gold production in the world?
- 9.6 Calculate the contribution that Africa made to the world's gold production in January 2017.
- 9.7 At the end of which year did South Africa's gold production drop to its lowest point?
- 9.8 Is the most recent production of gold in South Africa showing an increasing or decreasing trend? $(8 \times 1) (8)$

QUESTION 10

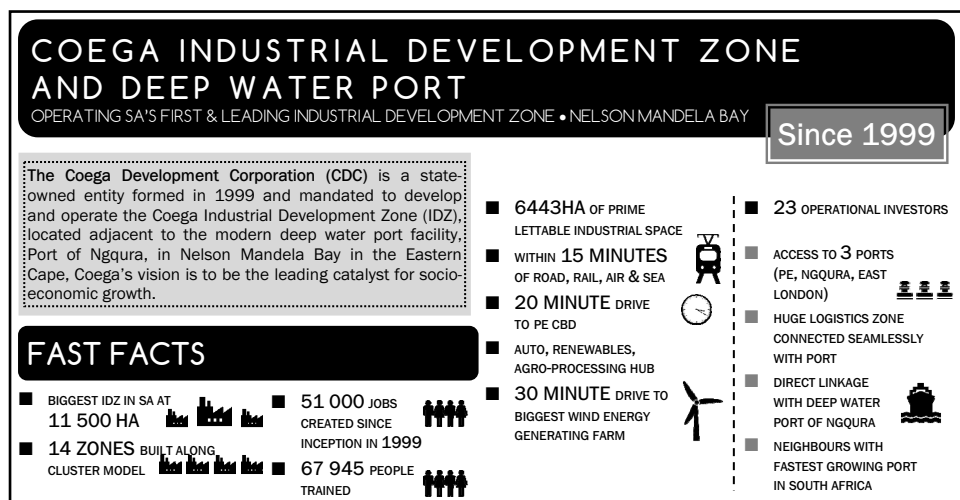
Refer to the diagram below based on industrial development zones (IDZ), which create opportunities for industrial decentralisation.



- 10.1 Give an example of an IDZ in South Africa. $(1 \times 1) (1)$
- 10.2 What is the main aim of an IDZ? $(1 \times 1) (1)$
- 10.3 How does an IDZ create the opportunity for industrial decentralisation? $(2 \times 2) (4)$
- 10.4 State TWO advantages of industrial decentralisation for the core industrial regions in South Africa. $(2 \times 2) (4)$
- 10.5 Explain how an IDZ will improve local socio-economic conditions. $(2 \times 2) (4)$

QUESTION 11

Study the diagram below, which provides information about the Coega Industrial Development Zone (IDZ) in South Africa.

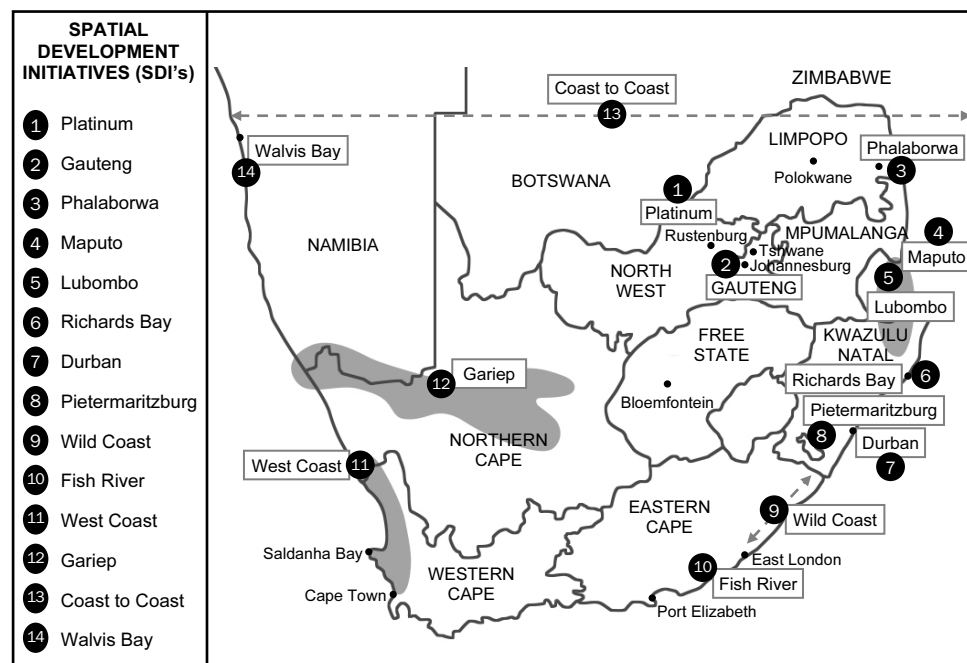


- 11.1 In which province in South Africa is Coega located? (1 × 1) (1)
- 11.2 Coega is the largest industrial development zone in South Africa. What is its size? (1 × 1) (1)
- 11.3 Name the deep-water port at Coega. (1 × 1) (1)
- 11.4 Give ONE reason for this port being so significant. (1 × 2) (2)
- 11.5 Explain why power supply would not be a problem in this area. (2 × 2) (4)
- 11.6 Discuss THREE factors that were taken into consideration in determining the location of the Coega IDZ. (3 × 2) (6)



QUESTION 12

Study the following map, showing the spatial development initiatives in South Africa.

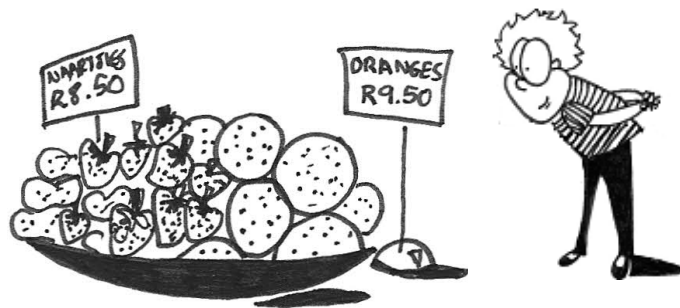


- 12.1 What is a *spatial development initiative (SDI)*? (1 × 1) (1)
- 12.2 Name a southern African country in the diagram which shares or works together with South Africa on the Maputo Development Corridor SDI. (1 × 1) (1)
- 12.3 Give ONE reason why the Wild Coast was selected to be developed as an SDI. (1 × 2) (2)
- 12.4 Discuss TWO ways in which the development of the Maputo Development Corridor SDI will benefit tourism. (2 × 2) (4)
- 12.5 Explain how the Maputo Development Corridor and the Wild Coast SDI have benefited the surrounding local communities. (3 × 2) (6)

QUESTION 13

Informal trade is a common feature in developing countries.

- 13.1 Define the term *informal sector*. (1 × 1) (1)
- 13.2 State the relationship between the unemployment rate and the percentage of people working in the informal sector. (1 × 2) (2)
- 13.3 Why is informal trade common in developing countries? (1 × 2) (2)
- 13.4 How would formalising businesses impact positively on the economy? (1 × 2) (2)
- 13.5 Write a paragraph of approximately EIGHT lines in which you suggest ways in which informal traders can be empowered to make a meaningful contribution to the South African economy. (4 × 2) (8)



NOTES



GEOGRAPHICAL SKILLS AND TECHNIQUES

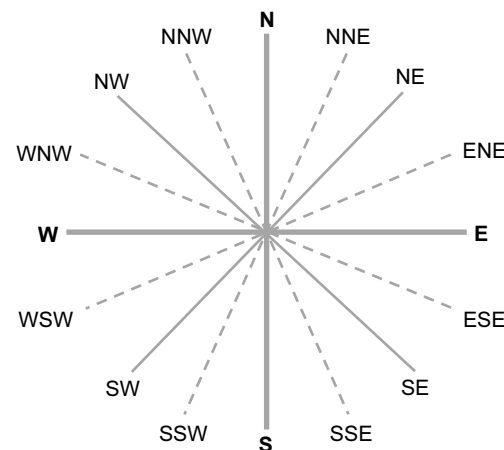
MAPWORK SKILLS



Topographic map	a type of map with large-scale detail that shows topographical features of the earth (mountains, valleys, rivers and vegetation)
Orthophoto map	a type of aerial photograph that has contour lines and various features indicated

Direction

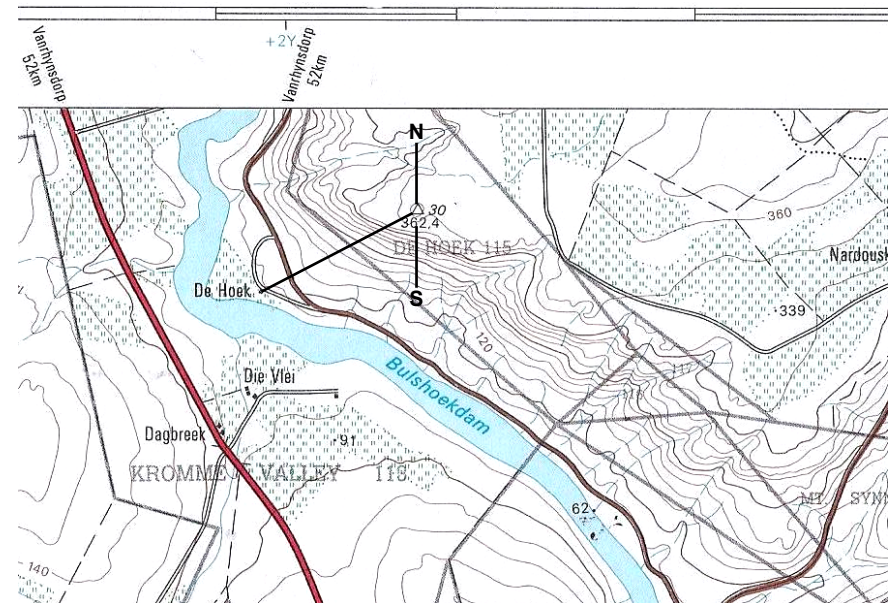
- Direction is expressed using the points of a compass (North, South, West, East) and the points between them.
- These are known as the **16 cardinal points**.



Note: North is always at the top of the map.

Worked Example

Refer to the map extract below. What is the direction of the farm De Hoek from trig beacon 30?



Answer:
southwest

Contour lines

- The brown lines on a topographic map are called **contour lines**.
- They join places of equal height in metres.
- The height is the same along one contour line.
- The closer together the contour lines are, the steeper the slope.

Position/Coordinates

- Coordinates are a set of values that show the exact position of an object or point.
- They consist of a latitude and a longitude coordinate.
- **Latitude** is the coordinate that specifies the **north-south** position of a point.
- **Longitude** is the coordinate that specifies the **west-east** position of a point.
- Latitude and longitude are given in **degrees** (symbol °), **minutes** (symbol ') and **seconds** (symbol ").
- When giving the position in the correct format, latitude (south) is given first followed by longitude (east).

*In South Africa, all places are **south** (latitude) and **east** (longitude).*

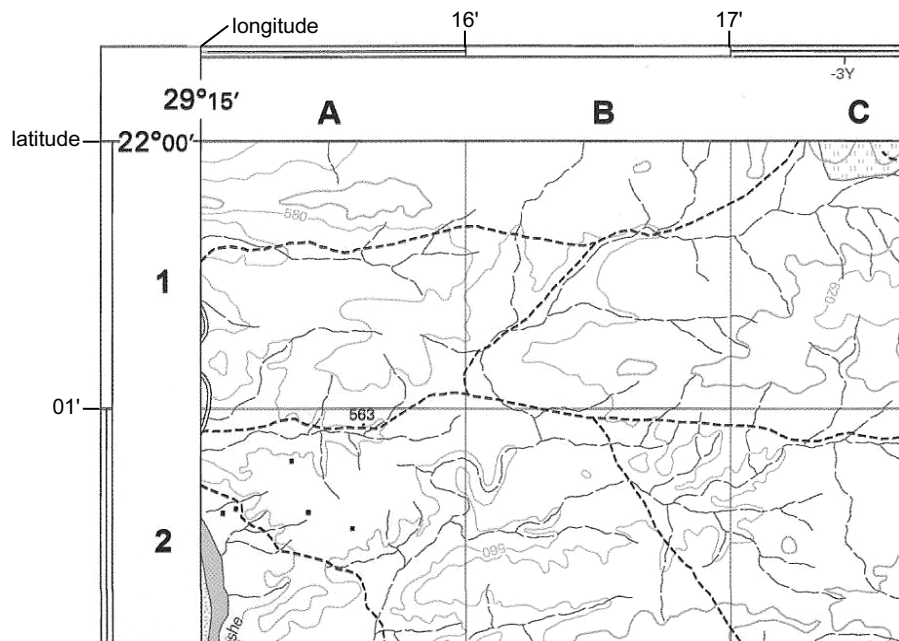


To determine position more accurately, each minute can be subdivided into **seconds** (symbol ").

$1^{\circ} = 60'$ (minutes) $1' = 60''$ (seconds)

1' can be divided into 6 equal parts, each part representing 10 seconds.

- On all 1 : 50 000 topographical maps coordinates are shown on the edges of the maps.
- The latitude (south) values are shown down the sides; the longitude (east) values are shown along the top and bottom of the map.



- The latitude and longitude values are subdivided into 1 minute (1') intervals.

*Latitude values increase as one moves south (down).
Longitude values increase as one moves east (right).*



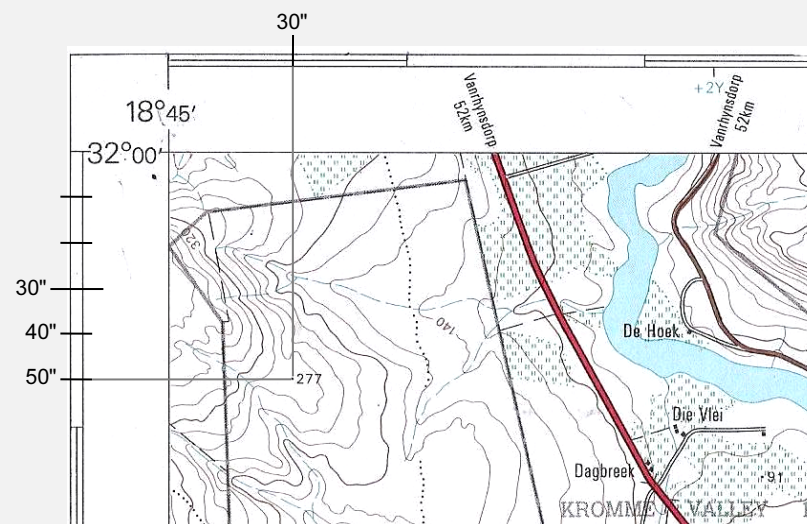
- To determine the precise location of a place, the lines of latitude and longitude that pass through the place need to be read off the map.

Method

The method of finding the coordinates of a specific point is explained by using the following example.



Determine the coordinates of the spot height .277 on the map extract below.



- Draw imaginary horizontal and vertical lines that meet at spot height .277 and extend to the side (latitude) and top (longitude) where the values are indicated.

Actual lines need not be drawn - a ruler can be used to position the points.

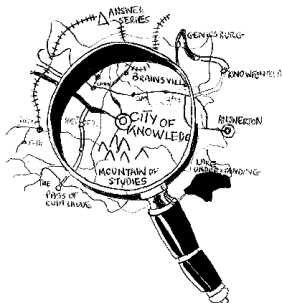


- ▶ The latitude value of .277 is read on the side of the map.
 - ▶ The degree value is 32° .
 - ▶ The minute value falls between $0'$ and $1'$. The correct minute reading is $0'$.
 - ▶ The seconds ($"$) value falls between $0'$ and $1'$. The minute bar is divided into 60 seconds.
 - ▶ Lightly divide the minute bar in half, then divide each half into three equal spaces ($10''$ each). This will help you to read the position in seconds.
 - ▶ The correct seconds reading is $50''$.
 - ▶ Latitude = $32^{\circ} 00' 50''$ S
- ▶ The longitude value of .277 is read at the top of the map.
 - ▶ The degree value is 18° E.
 - ▶ The minute value falls between $45'$ and $46'$. The correct minute reading is $45'$.
 - ▶ The seconds value is between $45'$ and $46'$. Divide the minute bar as you did for the latitude reading.
 - ▶ The correct seconds reading is $30''$.
 - ▶ Longitude = $18^{\circ} 45' 30''$ E

Answer:

$32^{\circ} 00' 50''$ S $18^{\circ} 45' 30''$ E

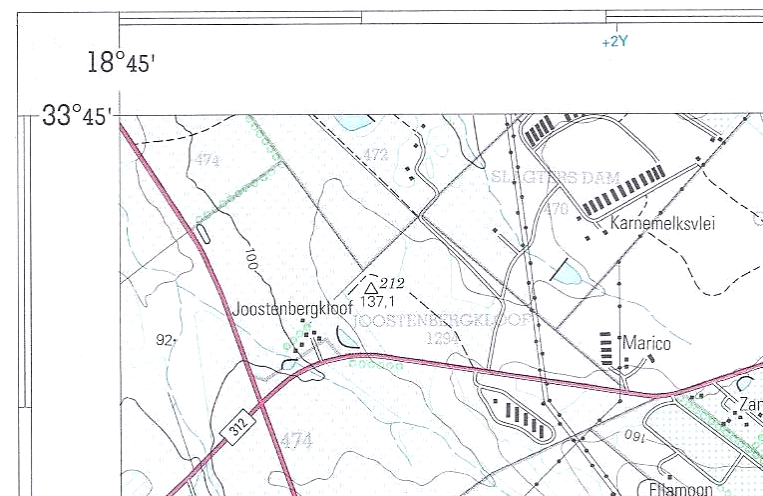
Remember: First latitude, followed by longitude.



Test Your Understanding 1

(Answers on p. 125)

Determine the coordinates of trig beacon 212 on the map extract below.



Map sheet reference

- ▶ The map sheet reference is the **title of the map** and refers to the area that the map covers.
- ▶ The map of South Africa is divided into squares that are one degree by one degree ($1^{\circ} \times 1^{\circ}$).
- ▶ Each map has a code which indicates its position on a grid covering South Africa.
- ▶ The map sheet reference is found at the top of the map in front of the name of the place shown on the map.



Example:

- ▶ The map of Mapungubwe has a map sheet reference code of **2229AB**.

- ▶ This code can be broken down as follows:

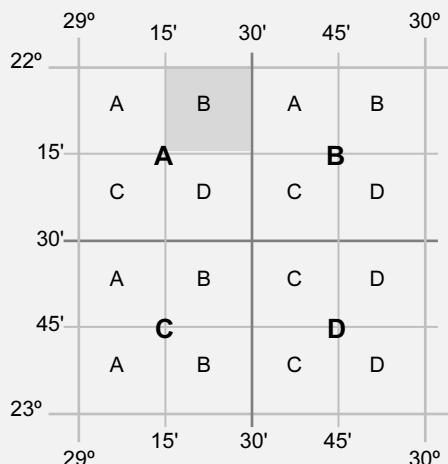
- ▶ 22 = 22° South (latitude)

- ▶ 29 = 29° East (longitude)

- ▶ AB refers to squares A and B

The area of ($1^\circ \times 1^\circ$) within these lines of latitude and longitude is divided into 4 big squares, labelled A, B, C and D. Each big square is subdivided into 4 smaller squares, also labelled A, B, C and D.

(AB in the map sheet reference of Mapungubwe therefore refers to big square A and small square B).



- ▶ The map sheet reference of Mapungubwe 2229AB is shaded on the grid above.

You must be able to give the map sheet reference in any direction from a given map sheet reference.



Worked Examples

1. Give the map sheet reference of the map immediately to the east of Mapungubwe 2229AB.

Answer: 2229BA

2. Give the map sheet reference of the map immediately to the north of Mapungubwe 2229AB.

Answer: 2129CD

Test Your Understanding 2

(Answers on p. 125)

The map sheet reference of Clanwilliam is 3218BB.

1. Give the map sheet reference of the map directly to the south of 3218BB.
2. Give the map sheet reference of the map directly to the east of 3218BB.

Bearing

- ▶ Bearing is an accurate way of giving the direction of one place in relation to another. It is a compass point measured in degrees from 0° to 360° .
- ▶ We distinguish between **true bearing** and **magnetic bearing**.

True bearing

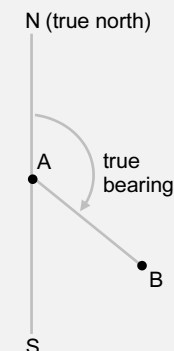
- ▶ **True bearing (TB)** is the angle measured clockwise from true north to a specific point or position.

True north is the direction towards the geographic north pole.



Method

- ▶ Draw a north-south line through the place **from** which the measurement is to be taken (e.g. A).
- ▶ Draw a straight line between the two places, e.g. A and B.
- ▶ Place a protractor along the north-south line with 0° on the north-south line.
- ▶ Measure the angle in a clockwise direction from the true north line to the bearing line A to B.
- ▶ The answer will be in degrees, e.g. 129° .

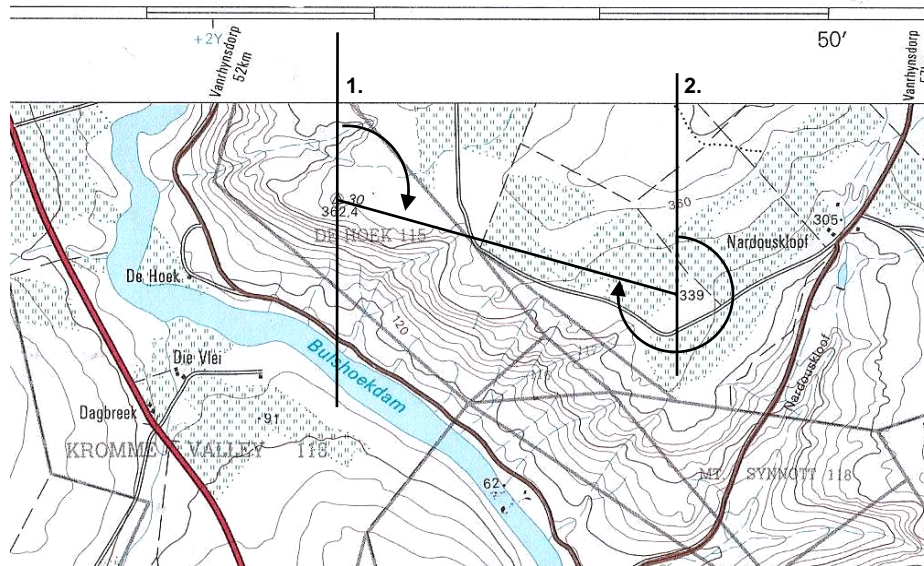


Worked Example

Study the map extract below and calculate the true bearing of:

- spot height .339 from trig beacon 30.
- trig beacon 30 from spot height .339.

Remember to measure the angle in a **clockwise** direction.



Answer:

- 105°

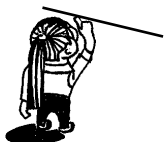
Take note: The true bearing is from trig beacon 30, so draw the north-south line through the Δ of trig beacon 30.



- $180^\circ + 105^\circ = 285^\circ$



Take note: The true bearing is from spot height .339, so draw the north-south line through the spot height. In this instance the true bearing is greater than 180°.

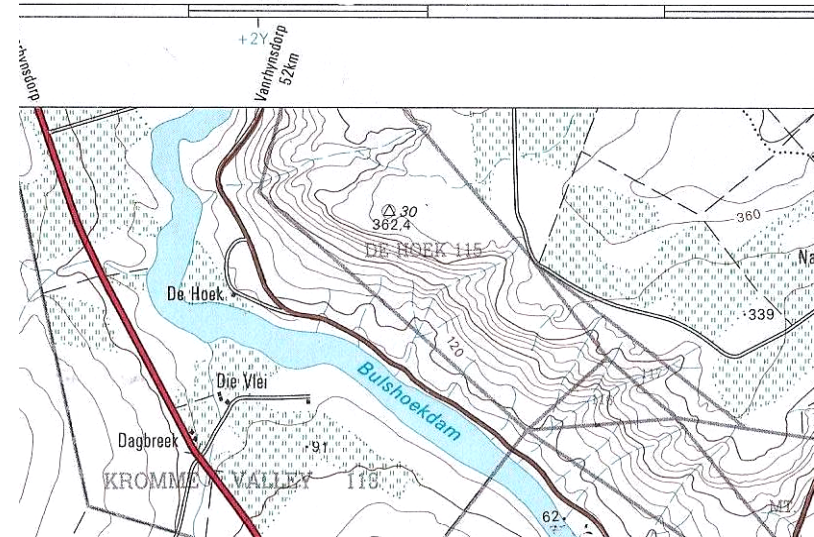


Test Your Understanding 3

(Answers on p. 125)

Study the map extract below and calculate the true bearing of:

- the farmhouse at De Hoek (shown as ■) from trig beacon 30.
- the trig beacon 30 from the farmhouse at De Hoek.



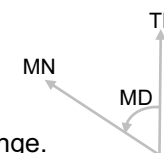
Magnetic declination

- Magnetic declination (MD)** is the angle between true north and magnetic north.



Magnetic north is the north direction to which a compass would point. On South African maps magnetic north will always be west of true north.

- This angle is calculated when the map is drawn, but the position of magnetic north changes, so the angle between true north and magnetic north (the magnetic declination) will also change.



TN: true north
MN: magnetic north
MD: magnetic declination



- The magnetic declination for the year the map was drawn appears at the bottom of the map.

Example: Information on the Mapungubwe map

Mean magnetic declination $12^{\circ} 21'$ West of True North (July 2001).
Mean annual change $3'$ westwards (1995 - 2000).

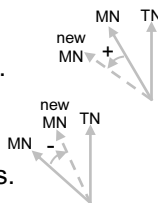
- **July 2001** refers to the month and year that the mean magnetic declination was recorded.
- **Mean annual change** refers to how much the magnetic declination changes each year.
- **(1995 - 2000)** refers to the years that were used to calculate the mean (average) magnetic declination.

- Magnetic declination can change in a **westerly direction** and the angle between true north and magnetic north increases.

OR

Magnetic declination can change in an **easterly direction** and the angle between true north and magnetic north decreases.

- It is necessary to calculate the magnetic declination for the current year.



Method

- You will need the following information from the map:
 - Mean magnetic declination
 - The year that the declination was recorded
 - The mean annual change
 - Mean annual change westwards or eastwards?

The year the declination was recorded is given as a month and year, e.g. July 2001. Use only the year (2001).



- Calculate the difference in years between the current year and the year that the magnetic declination was recorded.
- Multiply the mean annual change by the difference in years.
- If the mean annual change is **westwards** **add** the change to the given magnetic declination.
- If the mean annual change is **eastwards** **subtract** the change from the given magnetic declination.

Worked Example

Use the given information from the Mapungubwe map and calculate the magnetic declination for Mapungubwe in 2014.

Answer:

Present year = 2014

Mean magnetic declination = $12^{\circ} 21'$

Year magnetic declination was recorded = 2001

Mean annual change = $3'$ westwards



Take note: The years (1995 - 2000) given on the map are not used in the calculation.

- Difference in years: $2014 - 2001 = 13$ years
- Multiply mean annual change by difference in years: $13 \times 3' = 39'$
- Mean annual change is **westwards**, therefore **add** to the given mean magnetic declination.

$$\therefore 12^{\circ} 21' + 39' = 12^{\circ} 60'$$

Remember: there are $60'$ in 1° .



- Therefore the **final answer** is:

$13^{\circ} 00'$ west of true north

Remember: MD is always west of true north.



Take note of the following when doing magnetic declination calculations.

What to do if:

❶ Your answer has minutes greater than 59', e.g. $24^{\circ} 71'$

- ▶ you need to convert the minutes to degrees
- ▶ $71' = 1^{\circ} 11'$
- ▶ add the 1° to 24°
- ▶ final answer will be $25^{\circ} 11'$

$60' = 1^{\circ}$

❷ You have to subtract a larger number of minutes from a smaller number,

e.g. mean magnetic declination = $22^{\circ} 13' \text{ W}$
mean annual change = 23'

- ▶ if the mean annual change is eastwards, it needs to be subtracted from the mean magnetic declination:

$22^{\circ} 13' \text{ W} - 23'$

- ▶ before subtracting, convert 1° into minutes so that
 $22^{\circ} 13' = 21^{\circ} 73'$

$1^{\circ} = 60'$

- ▶ continue subtraction:

$21^{\circ} 73' - 23'$
 $= 21^{\circ} 50'$

$\therefore \text{Magnetic declination} = 21^{\circ} 50' \text{ W}$

Test Your Understanding 4

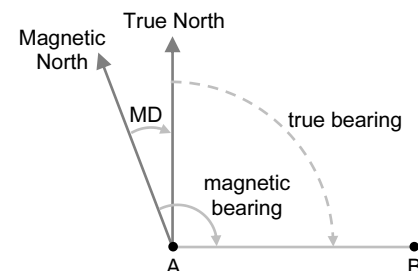
(Answers on p. 125)

Use the following information to calculate the magnetic declination for 2014.

- Mean magnetic declination $21^{\circ} 15'$ west of true north (1991.02).
Mean annual change 2' westwards (1990 - 1995).
- Mean magnetic declination $21^{\circ} 54'$ west of true north (1986.05).
Mean annual change 2' eastwards (1980 - 1985).

Magnetic bearing

- ▶ **Magnetic bearing** is the angle between magnetic north (MN) and a given point.



- ▶ Calculate the magnetic bearing by using the following formula:



Magnetic Bearing = True Bearing + Magnetic Declination

Method

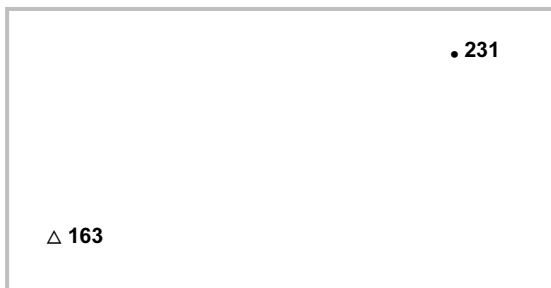
- ▶ Calculate the **true bearing** as explained on p. 108.
- ▶ Calculate the **magnetic declination** as explained on p. 109.
- ▶ Add the true bearing to the magnetic declination.

Take note that the answer must **not** have direction (N, S, E or W) as it is an angle measured in degrees and minutes.



Worked Example

Use the information below to calculate the magnetic bearing from trig beacon 163 to spot height .231.



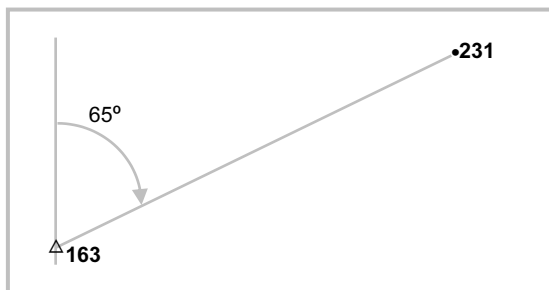
Answer:



Remember:

Magnetic bearing = True bearing + Magnetic declination

► True bearing = 65° .



► Magnetic declination:

► $2014 - 1999 = 15$ years

► $15 \times 3' W = 45'$

► Magnetic declination = $21^\circ 14' + 45'$

= $21^\circ 59'$ west of true north

► Magnetic bearing = True bearing + Magnetic declination

= $65^\circ + 21^\circ 59'$

= $86^\circ 59'$

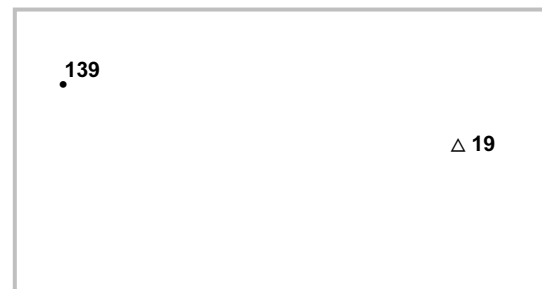
Remember: No direction
as it is an angle.



Test Your Understanding 5

(Answers on p. 126)

Use the information below to calculate the magnetic bearing of spot height .139 from trig beacon 19.



Mean magnetic declination $20^\circ 04'$ west of true north (2002.06)

Mean annual change $2'$ westwards (1999 - 2005)

Map scale

Topographical Map

Scale = 1 : 50 000

1 cm on the topographical map represents 50 000 cm (0,5 km) on the ground.



1 cm : 50 000 cm
1 cm : 500 m
1 cm : 0,5 km

Orthophoto Map

Scale = 1 : 10 000

1 cm on the orthophoto map represents 10 000 cm (0,1 km) on the ground.



1 cm : 10 000 cm
1 cm : 100 m
1 cm : 0,1 km

Map scales are expressed in **three ways**:

1 Representative Fraction/Ratio

- ▶ As a fraction: $\frac{1}{50\,000}$
- ▶ As a ratio: 1 : 50 000

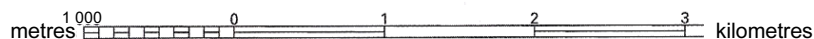


NOTE:

- ▶ The larger the denominator, the smaller the scale so less detail is shown, e.g. a map with a scale of 1 : 25 000 000 shows less detail than one with a scale of 1 : 50 000.
- ▶ A large scale is used to draw a map of a small area, e.g. 1 : 100 shows a lot of detail.
- ▶ A small scale is used to draw a map of a large area, e.g. 1 : 1 000 000. Not much detail is shown as the map represents a large area.
- ▶ The scale of an orthophoto map (1 : 10 000) is larger than the scale of a topographical map (1 : 50 000). That is, it shows more detail.

2 Line scale

- ▶ A line scale is a horizontal line drawn on a map that is divided into a number of equal parts.
- ▶ A line scale is accurate and no calculations are used.
- ▶ It is divided into two main parts:
 - ▶ To the right of zero - each division of the scale represents a distance of 1 km.
 - ▶ To the left of zero - the distance represents 1 km (1 000 m) subdivided into 10 equal parts, each representing a distance of 100 m.



2 cm = 1 km



3 Word Scale

- ▶ A word scale indicates scale by means of a verbal statement, e.g. 1 cm on the map represents 500 m on the ground.

Distance

- ▶ Distance on a map is calculated between two points.
- ▶ Use the following formula to calculate distance on a map:



Actual distance = distance on map × scale



When doing distance calculations, you will be asked to give your answer in kilometres or metres. The calculations for a topographical map and an orthophoto map differ, because their scales differ.

Straight line distance

Method

- ▶ Use a ruler to measure the distance between two points in cm.



Note: Measure accurately from the middle of the one point to the middle of the other.

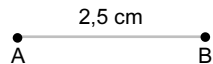
- ▶ Remember the following:

Scale	Answer in km	Answer in m
1 : 50 000 (topographical map)	▶ multiply by 0,5	▶ multiply by 500
1 : 10 000 (orthophoto map)	▶ multiply by 0,1	▶ multiply by 100



Worked Examples

- On a topographical map (scale 1 : 50 000)



Calculate the actual distance between point A and B in kilometres.

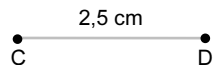
Answer:

Distance measured on topographical map in cm: 2,5 cm

Scale: 1 cm represents 0,5 km in reality

$$\begin{aligned}\therefore \text{Distance} &= 2,5 \times 0,5 \\ &= 1,25 \text{ km}\end{aligned}$$

- On an orthophoto map (scale 1 : 10 000)



Calculate the actual distance between point C and D in kilometres.

Answer:

Distance measured on orthophoto map in cm: 2,5 cm

Scale: 1 cm represents 0,1 km in reality

$$\begin{aligned}\therefore \text{Distance} &= 2,5 \times 0,1 \\ &= 0,25 \text{ km}\end{aligned}$$

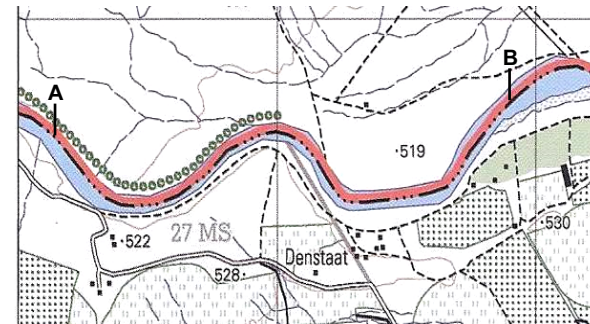
Curved line distance

Method

- ▶ Place the straight edge of a piece of paper along the feature to be measured, e.g. road.
- ▶ Mark the beginning point of the feature on the edge of the paper. Hold the paper steady with the point of a pencil.
- ▶ Swivel the paper to follow the road.
- ▶ Mark where the paper intersects with the road.
- ▶ Mark the end point of the road on the paper.
- ▶ Measure the distance marked off on the paper.
- ▶ Calculate the distance in reality by using the scale of the map.

Worked Example

Calculate the distance along the international boundary from A to B, on the topographical map extract below, in kilometres.



Answer:

Distance measured on map in cm: 7,5 cm

Scale: 1 cm represents 0,5 km in reality

$$\begin{aligned}\therefore \text{Distance} &= 7,5 \times 0,5 \\ &= 3,75 \text{ km}\end{aligned}$$

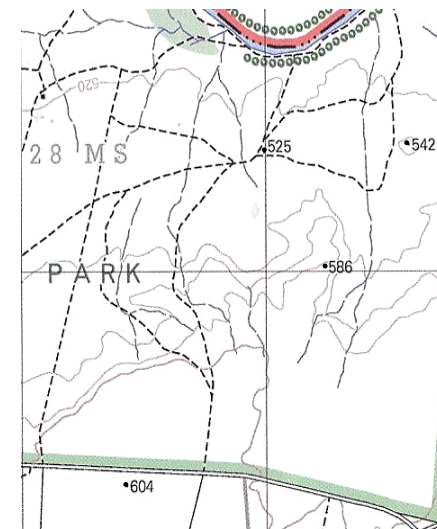
Remember it is a topographical map with scale 1 : 50 000.



Test Your Understanding 6

(Answers on p. 126)

- Calculate the following distances on the topographical map extract below.



- 1.1 Calculate the distance from spot height .604 to spot height .542 in kilometres.
- 1.2 Calculate the distance from spot height .586 to spot height .525 in metres.
2. Calculate the distance from A to B in kilometres on the orthophoto map extract below.



Area

- Area is the measurement of the size of a surface.

Area of a regular shape, e.g. square or rectangle

- If the area to be determined is a square or a rectangle, use the following formula:



$$\text{Area (A)} = \text{length (}\ell\text{)} \times \text{breadth (b)}$$

Method

- Measure the length in cm and convert to km or m.
- Measure the breadth in cm and convert to km or m.
- Multiply the length by the breadth.
- Write the answer in kilometres squared (km²) or metres squared (m²).

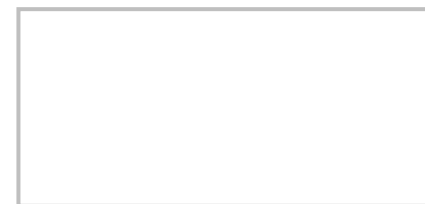


Note: Convert all your measurements **before** you calculate your answer.

Worked Examples

1. Topographical map calculation (scale 1 : 50 000)

5,6 cm on map



2,6 cm on map

Answer in km²:

$$\ell = 5,6 \text{ cm} \times 0,5 = 2,8 \text{ km}$$

$$b = 2,6 \text{ cm} \times 0,5 = 1,3 \text{ km}$$

$$\begin{aligned} A &= \ell \times b \\ &= 2,8 \times 1,3 \\ &= 3,64 \text{ km}^2 \end{aligned}$$

Remember: 1 cm on a 1 : 50 000 map represents 0,5 km.



Answer in m²:

$$\ell = 5,6 \text{ cm} \times 500 = 2\,800 \text{ m}$$

$$b = 2,6 \text{ cm} \times 500 = 1\,300 \text{ m}$$

$$\begin{aligned} A &= \ell \times b \\ &= 2\,800 \text{ m} \times 1\,300 \text{ m} \\ &= 3\,640\,000 \text{ m}^2 \end{aligned}$$

1 cm on map = 0,5 km = 500 m



2. Orthophoto map calculation (scale 1 : 10 000)

5,6 cm on photo



2,6 cm on photo

Answer in km²:

$$\ell = 5,6 \text{ cm} \times 0,1 = 0,56 \text{ km}$$

$$b = 2,6 \text{ cm} \times 0,1 = 0,26 \text{ km}$$

$$\begin{aligned} A &= \ell \times b \\ &= 0,56 \times 0,26 \\ &= 0,1456 \text{ km}^2 \end{aligned}$$

Remember: 1 cm on a 1 : 10 000 orthophoto map represents 0,1 km.



Answer in m²:

$$\ell = 5,6 \text{ cm} \times 100 = 560 \text{ m}$$

$$b = 2,6 \text{ cm} \times 100 = 260 \text{ m}$$

$$A = \ell \times b$$

$$= 560 \times 260$$

$$= 145\,600 \text{ m}^2$$

$$1 \text{ cm on map} = 0,1 \text{ km} = 100 \text{ m}$$



Test Your Understanding 7

(Answers on p. 126)

1. Calculate the area of the block below in square kilometres.



Scale 1 : 50 000

2. Calculate the area of the block below in square metres.



Scale 1 : 50 000

3. Calculate the area of the block below in square kilometres.



Scale 1 : 10 000

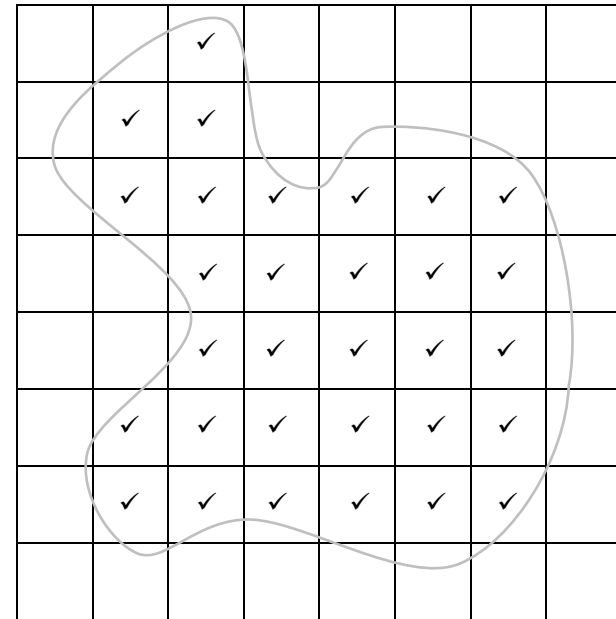
4. Calculate the area of the block below in square metres.



Scale 1 : 10 000

Area of an irregular shape

- If the shape is irregular, e.g. lake, dam, the area can be calculated by using the **grid method**.



Method

- Draw a 1 cm × 1 cm grid over the area. (If the feature is very small, a grid of 0,5 cm × 0,5 cm can be drawn over the feature.)
- Count all the full squares covered by the grid as well as the number of squares that are more than half covered by the grid.
- Determine the area of one block:

$$1 \text{ cm} \times 1 \text{ cm} = 0,5 \text{ km} \times 0,5 \text{ km} = 0,25 \text{ km}^2$$
- Multiply the area of one block (0,25 km²) by the number of counted squares.

$$0,25 \text{ km}^2 \times 31 = 7,75 \text{ km}^2$$

$$1 \text{ cm on map} = 0,5 \text{ km in reality.}$$



Gradient

- ▶ Gradient is the relationship between vertical height and horizontal distance.
- ▶ It is the measure of steepness of a slope.
- ▶ Use the following formula to calculate gradient:



$$\text{Gradient} = \frac{\text{Vertical Interval (VI)}}{\text{Horizontal Equivalent (HE)}}$$

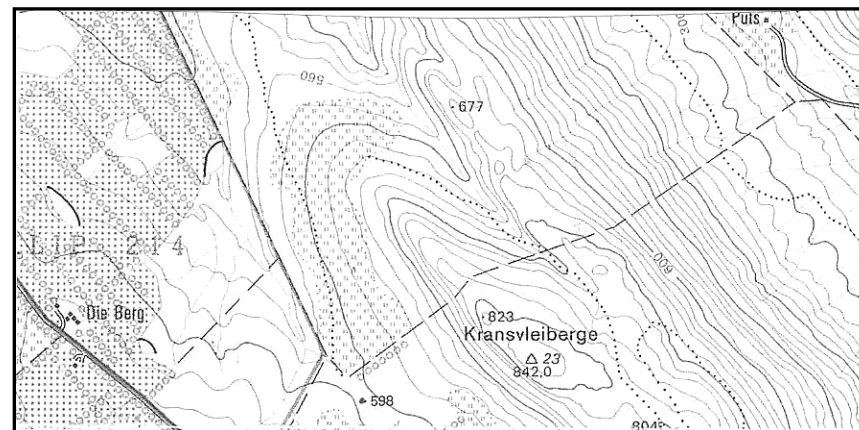
Method

- ▶ **Vertical Interval (VI):**
 - ▶ Calculate the height difference between the two points in **metres**.
 - ▶ Subtract the lowest height from the highest height.
- ▶ **Horizontal Equivalent (HE):**
 - ▶ Measure the distance between the two points in **centimetres**.
 - ▶ Convert the distance to **metres** by multiplying by 500 (topographical map) or by 100 (orthophoto map).
- ▶ **Gradient = $\frac{VI}{HE}$**
 - ▶ Divide both the numerator (number above the line) and the denominator (number below the line) by the value of the numerator.
 - ▶ e.g. $\frac{25}{100} = \frac{1}{4}$
 - ▶ Write your answer as a ratio, e.g. 1 : 4



Worked Example

Calculate the gradient of trig beacon 23 to spot height .598.



Take note:

Trig beacons are numbered; do not get confused with the number of the beacon and the height. The height is written below the Δ .



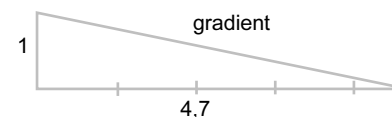
Answer:

$$\begin{aligned} VI &= 842 \text{ m} - 598 \text{ m} \\ &= 244 \text{ m} \end{aligned}$$

$$\begin{aligned} HE &= 2,3 \text{ cm} \times 500 \\ &= 1\,150 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{Gradient} &= \frac{VI}{HE} \\ &= \frac{244}{1\,100} = \frac{1}{4,713} = 1 : 4,7 \end{aligned}$$

This represents a slope rising 1 m over a distance of 4,7 m.



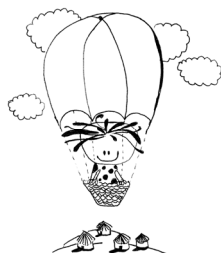
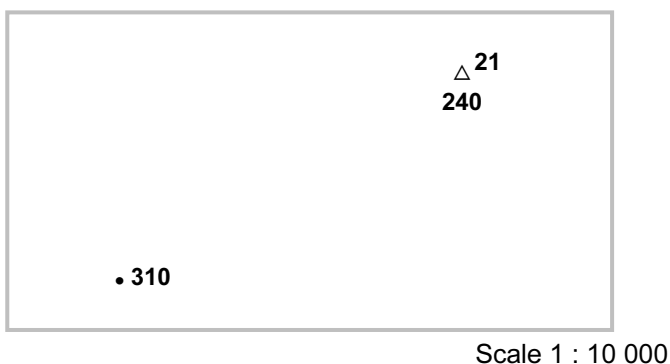
Test Your Understanding 8

(Answers on p. 126)

1. Calculate the gradient of trig beacon 15 to spot height .200.



2. Calculate the gradient of trig beacon 21 to spot height .310.



Cross sections

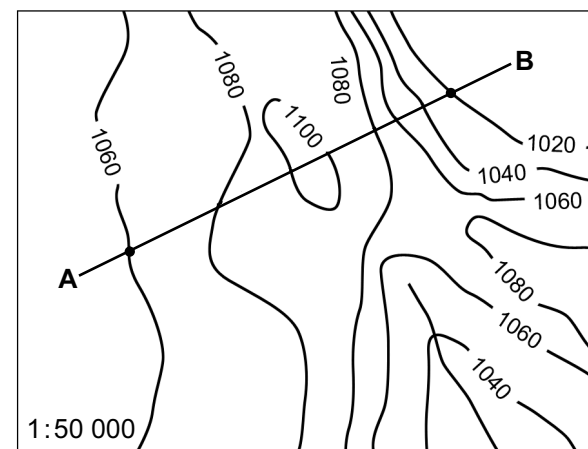
- ▶ A cross section is a drawing of the side view of a landform, e.g. a hill or a mountain.

Method

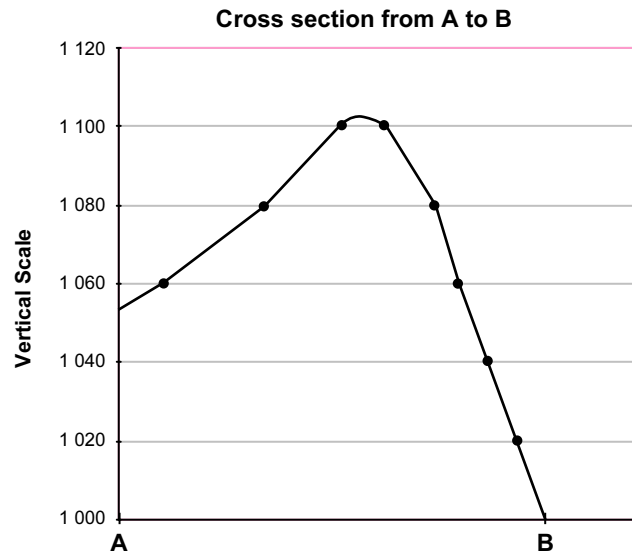
- ▶ Draw a straight line between the points, e.g. point A and point B.
- ▶ Use a strip of paper and place it along the line.
- ▶ Mark off each contour line and record its height in metres.
- ▶ Transfer the data to graph paper or draw a grid with a vertical and a horizontal axis.
- ▶ The vertical axis shows the height and the horizontal axis shows the distance.
- ▶ On the vertical axis mark off a scale, e.g. 1 cm : 20 m. The horizontal scale is the length between points A to B, e.g. 4,5 cm.
- ▶ Place the strip of paper on the horizontal line and plot the heights to correspond with the heights on the vertical axis. Mark the position with a dot.
- ▶ Join the dots to complete the cross section.

Worked Example

Draw a cross section from point A to B shown on the map extract below.



Answer:



Horizontal Scale 1 : 50 000

Vertical exaggeration

- ▶ If the vertical and horizontal scales of a cross section are the same, the differences in slope is not easily distinguished.
- ▶ To make the slope more obvious or clear, the profile is drawn with a degree of vertical exaggeration.
- ▶ It is necessary therefore to calculate the vertical exaggeration (VE) of a cross section, by using the following formula:



$$\text{Vertical Exaggeration (VE)} = \frac{\text{Vertical Scale (VS)}}{\text{Horizontal Scale (HS)}}$$



Method

- ▶ Determine the **horizontal scale** (HS). This is the scale of the topographical map (1 : 50 000) or the orthophoto map (1 : 10 000).
- ▶ Write the horizontal scale (HS) as a fraction, e.g. $\frac{1}{50\,000}$
- ▶ Change the **vertical scale** (VS) from a word scale to a representative fraction.
- ▶ The VS is the scale used on the vertical axis of the cross section, e.g. 1 cm : 20 m.

- ▶ Convert the metres to centimetres, e.g. 1 cm : 20 m

$$\therefore 1 \text{ cm} : 2\,000 \text{ cm}$$

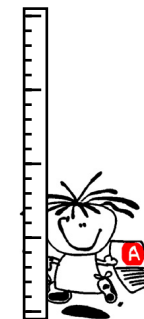
Remember:
1 m = 100 cm

- ▶ Write the VS as a representative fraction, e.g. $\frac{1}{2\,000}$
- ▶ Determine the vertical exaggeration:

$$\begin{aligned} \text{VE} &= \frac{\text{VS}}{\text{HS}} \\ &= \frac{\frac{1}{2\,000}}{\frac{1}{50\,000}} \text{ m1} \\ &= \frac{1}{2\,000} \times \frac{50\,000}{1} \\ &= 25 \end{aligned}$$

To divide in a fraction change the sign to multiply and invert the fraction.

- ▶ The answer tells how many times the cross section has been exaggerated, e.g. VE = 25 times.



Worked Example

Calculate the vertical exaggeration of the cross section from A to B on p. 119 (left-hand side).

Answer:

Vertical Scale: Scale of the cross section

1 cm : 20 m

$\therefore 1 : 2\,000$ or $\frac{1}{2\,000}$

1 m = 100 cm



Horizontal Scale: Scale of Map

1 : 50 000 (or $\frac{1}{50\,000}$)

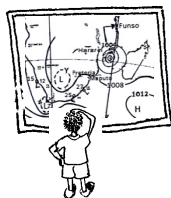
$$\begin{aligned}\text{Vertical Exaggeration} &= \frac{\text{VS}}{\text{HS}} \\ &= \frac{\frac{1}{2\,000}}{\frac{1}{50\,000}} \\ &= \frac{1}{2\,000} \times \frac{50\,000}{1} = \frac{50}{2} \\ &= 25\end{aligned}$$

$\therefore$ The vertical exaggeration of the cross section is 25 times

Test Your Understanding 9

(Answers on p. 126)

1. Calculate the vertical exaggeration of a cross section drawn from a topographical map 1 : 50 000 with a vertical scale of 1 cm representing 10 m.
2. Calculate the vertical exaggeration of a cross section drawn from an orthophoto map 1 : 10 000 with a vertical scale of 1 cm representing 30 m.



Intervisibility

- Intervisibility refers to whether one place is visible from another place.

Method

- Draw a line on the cross section joining the points between the two places.
- If the line cuts through any part of the cross section, there is no intervisibility. If it does not cut through, the two points are intervisible.

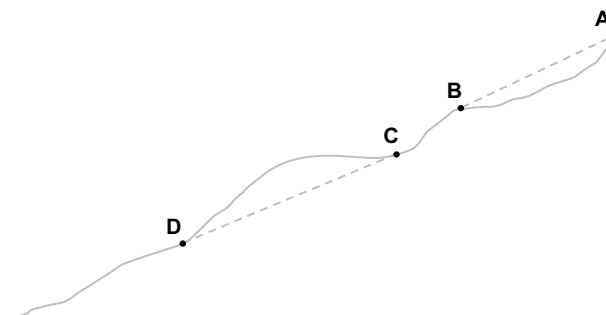
In the exam you may be given a cross section and asked to determine the vertical exaggeration of the cross section and then to determine if the two points are intervisible.



Worked Example

Study the following and determine if:

1. points A and B are intervisible.
2. points C and D are not intervisible.



Answer:

1. Points A and B are intervisible.
2. Points C and D are not intervisible.



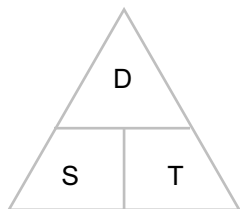
Speed, Distance and Time

- ▶ Speed is measured as distance travelled per unit of time.
- ▶ Use the following formula to calculate the speed at which an object moves:



$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$

- ▶ The formula triangle below is a helpful tool to remember how to calculate the time it would take to travel a given distance at a given average speed.



D = distance
S = speed
T = time

If $\text{Speed} = \frac{\text{distance}}{\text{time}}$ then $\text{Distance} = \text{speed} \times \text{time}$

and $\text{Time} = \frac{\text{distance}}{\text{speed}}$

Worked Examples

1. At what speed will you be travelling if it took 12 minutes to travel between two points along the road (13,8 cm on the map)?

$$\text{Distance} = 13,8 \text{ cm} \times 0,5 = 6,9 \text{ km}$$

$$\text{Time} = 12 \text{ minutes} = 0,2 \text{ hours} \dots \left(\frac{12}{60} \right)$$

1 cm on map = 0,5 km in reality.



Answer:

$$\begin{aligned} \text{Speed} &= \frac{\text{distance}}{\text{time}} \\ &= \frac{6,9 \text{ km}}{0,2 \text{ h}} \\ &= 34,5 \text{ km/h} \end{aligned}$$



2. What distance will you cover if the speed you travelled at was 60 km/h and it took you 12 minutes?

Answer:

$$\text{Speed} = 60 \text{ km/h}$$

$$\text{Time} = 12 \text{ minutes} = 0,2 \text{ hours} \dots \left(\frac{12}{60} \right)$$

$$\begin{aligned} \text{Distance} &= \text{speed} \times \text{time} \\ &= 60 \text{ km/h} \times 0,2 \text{ h} \\ &= 12 \text{ km} \end{aligned}$$

ORTHOPHOTO MAPS



Note: Always use both the orthophoto map **and** the topographical map when answering questions in your exam.

Shadows

- ▶ The direction of shadows can determine the time of day that the orthophoto was taken, while the length of the shadow can help to determine the time of the year.

Time of day

- ▶ Look at the shadows of trees or high buildings. If the shadow lies in a south-westerly direction it indicates that the sun is still lying relatively far to the east. The photo was thus taken in the morning.
- ▶ If the shadow lies to the south the photo was taken at ± 12 noon.
- ▶ If the shadow lies to the southeast the photo was taken in the afternoon.

The shortest shadow is at noon. The longer the shadow, the earlier (am) or later (pm) it is, depending on the orientation.



Time of the year

- ▶ Use the date on the photo (if provided).
- ▶ Look for signs of rainfall. (Is it a summer or winter rainfall area?)

Tone and texture

- ▶ If the cultivated lands are light in colour, then crops have been sown or are still very young, signifying winter time in a summer rainfall area or summer in a winter rainfall area.
- ▶ If the crops are darker in colour then they are fully grown, signifying the middle of summer in a summer rainfall area or the middle of winter in a winter rainfall area.
- ▶ Where plantations reveal regular ordered planting, these are obviously planted by man.
- ▶ Crops show a regular colour and texture and often follow the contours.
- ▶ Orchards have a dotted appearance and regularly spaced rough appearance.
- ▶ Vineyards also have a dotted appearance; smaller of texture than orchards with a clear linear form. With trellised vines it is possible to detect the connecting wires together with the dotted appearance.

Urban areas

CBD

- ▶ This is the part where the densest development and highest buildings occur.
- ▶ The street pattern is usually a grid pattern.

Flats/Apartments

- ▶ These are usually just on the outskirts of the CBD adjacent to parking areas.
- ▶ Big and high buildings (not as dense as the CBD).

High income residential areas

- ▶ Houses of varying sizes, selectively positioned on large plots (occasionally with swimming pool and tennis court).

If two residential areas are given, the oldest and more established of the two is the one with the most and largest growth of trees because new neighbourhoods would have small newly planted trees and shrubs.



Low income residential areas

- ▶ Houses are uniform, neatly arranged in rows on very small plots. (Modern RDP-houses).

Informal settlements

- ▶ Shacks randomly positioned usually with no obvious street pattern.

Industries and factories

- ▶ Normally outside residential areas with access to road and railway facilities.
- ▶ Large plots with large single story buildings.

Schools

- ▶ Found in residential areas. Large buildings often with significant sports grounds.



The orthophoto map is usually more recently made than the topographical map. Look out for new roads, buildings or man-made features which occur on the one and not on the other. The one with the new features is the most recent.

MAP INTERPRETATION



Different features found on a topographical map are indicated by specific symbols. The key showing these symbols is found at the bottom of the map. Memorise the most important symbols to make interpretation of the map easier.

Relief

- ▶ Relief influences the land-use in an area.
- ▶ In the Southern Hemisphere the north-facing slopes are warmer than the south-facing slopes. People build houses and grow crops on north-facing slopes.
- ▶ Forestry often takes place on steeper slopes and crops are grown on gentle slopes.

Rivers and Water

- ▶ Non-perennial rivers and the presence of dams indicate seasonal rainfall in an area.
- ▶ The drainage patterns of rivers depend on the features of the landscape. You may be asked to determine the drainage pattern, e.g. dendritic, trellis.
- ▶ The total length and number of rivers in an area gives an indication of the drainage density.
- ▶ To determine the direction in which a river flows:
 - ▶ Rivers flow from the highest to the lowest point. Look at the spot heights and contours at various points along a river.
 - ▶ The contour lines point upstream in a valley.
 - ▶ Look at the tributaries joining the river. The direction in which they join the main river indicates the direction of flow.
- ▶ Wind pumps indicate seasonal rainfall. Often found in dry areas, e.g. sheep farming areas.
- ▶ Irrigation systems, furrows and canals indicate lower rainfall in a region.



Remember: A perennial river is indicated with a solid blue line on a topographical map and a non-perennial river with a broken blue line.

See p. 35



Agriculture

Commercial Farming

- ▶ Indications of commercial farming:
 - ▶ Farm names
 - ▶ Well-developed infrastructure - road systems, electricity, railways
 - ▶ Farm buildings, e.g. sheds, workers' homes
 - ▶ Irrigation systems, dams

Urban areas

Land-use zones

See p. 64



Street patterns

See p. 66



GEOGRAPHICAL INFORMATION SYSTEMS (GIS)

- ▶ GIS involves the use of computers to make maps. These maps can be made to suit the individual user's own purposes as he or she can select the data that they want to use or analyse.
- ▶ This information can be used in numerous fields and by people such as scientists, meteorologists, traffic controllers, town planners, environmentalists, businessmen, government departments, companies etc. Basically it can be used in any field that has a spatial component.

A bank can show on a map where all their branches and ATMs are located. They may then decide where they should locate their next outlet. To this information they could add things like population density, the wealth (buying power) of each suburb, the relief, roads, average cost of land, etc.



How can GIS help you?

- ▶ You decide what question you would like answered. The geographical data is then collected, put in the computer which analyses the information before giving you a visual representation of the data on a map.

Why use GIS?

- ▶ Computers make it easy to store large amounts of information, as information is digital compared to analogue (paper format).
- ▶ Once saved on the computer the data/material can be manipulated or changed.
- ▶ You do not have to print and store large paper maps.
- ▶ Being electronic, maps are easy to copy and send.

Components of GIS

GIS consists of **five** components:

- ▶ **Computer hardware** - computer, screen, keyboard, mouse, etc.
- ▶ **Software** - the programme that will allow you to enter information, edit, manipulate and put the information into map format.
- ▶ **Geographical data (information)** - it must be correct and accurate.

- ▶ **Personnel** - people operating the computers, entering the information and extracting the relevant information.
- ▶ **Methods or application of the material** - how the data is stored on the computer, e.g. raster or vector system.

Remote sensing

- ▶ This is the collection of information by a recording device that is not in direct contact with the area.
- ▶ Examples of remote sensing are observations taken from aircraft, satellites or an aerial photograph.
- ▶ Remote sensing is useful for collecting information from inaccessible and isolated places.

Data structures

Vector data

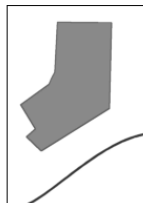
- ▶ The data/information shows geographic features in the form of points, lines or polygons. The information (e.g. coordinates) on each is stored separately in its own file.
 - ▶ **Point features** - indicate small features, e.g. spot heights, buildings, trig beacons.
 - ▶ **Line features** - indicate narrow linear features, e.g. rivers, roads.
 - ▶ **Polygon features** - include cultivated land, built-up areas and dams.

Raster data

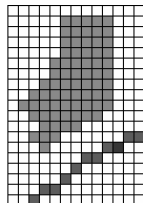
- ▶ Data is displayed as patterns within a grid system.
- ▶ The data is allocated in rows and columns on the map by the computer.
- ▶ The size of the cells will determine the accuracy of the map (pixels).
- ▶ The storage of raster data can use a lot of space on a computer system.



Real world



Vector



Raster

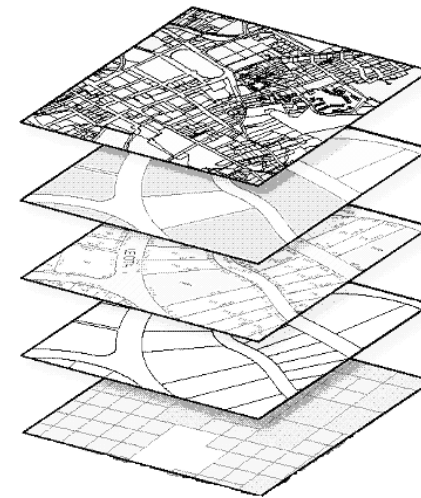
Data management

- ▶ **Spatial data** - data which describes the position of geographical features, e.g. towns, rivers, roads ∴ its coordinates.
- ▶ **Spatial resolution** - how clear and easy the detail is to see. It describes the size of the picture elements (pixels) that make up the image.

An orthophoto map has a high spatial resolution as it has a large scale and shows more detail than a map with a smaller scale.



- ▶ **Attribute data** - information which describes or gives the characteristics of a geographical feature (object). These characteristics can be qualitative and/or quantitative. Usually shown in table format and include numbers, length, area etc.
- ▶ **Buffering** - to demarcate (mark off) an area around an object. It is used for identifying areas surrounding geographical features.
- ▶ **Querying** - map features can be retrieved on the basis of attributes to selectively retrieve information.
- ▶ **Data layering** - when different kinds of data (vector or raster data) are placed one on top of the other to produce a map for a particular area. Layers of data may include: vegetation, e.g. farm land; contour lines; roads; power lines; built-up areas and rivers.



Data layering

MAP PROJECTIONS

- ▶ Maps are a representation of the earth on a flat surface and are used to find direction, distance and area.
- ▶ When maps are drawn from the spherical earth onto a flat surface, the **shape**, **distance**, **area** and **direction** change; these are called **distortions**.



Parallels: lines of latitude or horizontal lines (east - west)
Meridians: lines of longitude or vertical lines (north - south)

Mercator Projection

- ▶ In 1569 Mercator invented a projection that got directions right but exaggerated areas towards the poles.
- ▶ It was good for navigation but not for showing topography and countries to scale.

Transverse Mercator Projection

- ▶ In 1772 Lambert adapted Mercator's idea to show the spherical earth as if a cylinder of paper had been wrapped around it, touching it along a particular meridian (line of longitude).
- ▶ For this projection:
 - ▶ Scale is constant along the central meridian but increases to the west and east.
 - ▶ Areas become exaggerated towards the eastern and western edges of the map.
 - ▶ Shapes become distorted toward the western and eastern edges.
 - ▶ Directions are confusing but are accurate at the central meridian.
- ▶ This projection is excellent for mapping countries that are long from north to south. It can be used quite well for maps of Africa.
- ▶ For maps of smaller parts of the world, the projection was modified by having more than one central meridian.

Gauss Conformal Projection

- ▶ Gauss developed Lambert's idea further.
- ▶ His calculations recognised the earth as not a perfect sphere but **elliptical** (slightly flattened at the poles).
- ▶ It was drawn on strips or zones that were only 2° wide.
- ▶ This projection is useful for mapping countries that are long from north to south.
- ▶ Since 1999, South Africa has used a coordinate system based on the Gauss conformal projection.



MEMO

TEST YOUR UNDERSTANDING

Test Your Understanding 1

(p. 107)

Answer:

33° 45' 36" S 18° 46' 02" E

Test Your Understanding 2

(p. 108)

Answer:

1. 3218BD

2. 3219AA

Test Your Understanding 3

(p. 109)

Answer:

1. 242°

2. 62°

Test Your Understanding 4

(p. 111)

Answer:

1. Difference in years: 2014 - 1991 = 23 years

Multiply with mean annual change: $23 \times 2' = 46'$

Add to mean magnetic declination:

$$21^\circ 15' + 46'$$

$$= 21^\circ 61'$$

$$= 22^\circ 01'$$

Remember: $60' = 1^\circ$.



Mean annual change is westwards, therefore add to the given mean magnetic declination.



∴ Magnetic declination = 22° 01' west of true north

2. Difference in years: 2014 - 1986 = 28 years

Multiply with mean annual change: $28 \times 2' = 56'$

Subtract from mean magnetic declination:

$$21^\circ 54' - 56'$$

$$= 20^\circ 114' - 56'$$

$$= 20^\circ 58'$$

Remember: $1^\circ = 60'$.



Mean annual change is eastwards, therefore subtract from given mean magnetic declination.



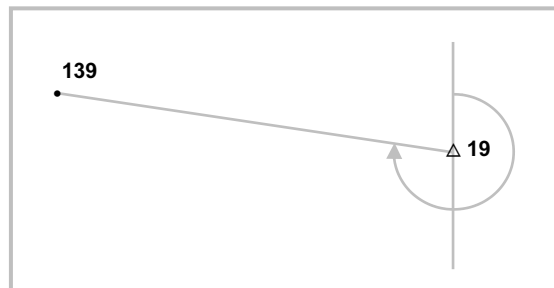
∴ Magnetic declination = 20° 58' west of true north

Test Your Understanding 5

(p. 112)

Answers:

- ▶ True bearing = 278°
- ▶ Magnetic declination:
 - ▶ $2014 - 2002 = 12$ years
 - ▶ $12 \times 2' = 24'$
 - ▶ Magnetic declination
 $= 20^\circ 04' + 24'$
 $= 20^\circ 28'$ west of true north
- ▶ Magnetic bearing = True bearing + Magnetic declination
 $= 278^\circ + 20^\circ 28' = 298^\circ 28'$

**Test Your Understanding 6**

(p. 114)

Answers:

- 1.1 Distance = $5,9 \text{ cm} \times 0,5 = 2,95 \text{ km}$
- 1.2 Distance = $1,7 \text{ cm} \times 500 = 850 \text{ m}$
2. Distance = $3,4 \text{ cm} \times 0,1 = 0,34 \text{ km}$

Test Your Understanding 7

(p. 116)

Answers:

- | | |
|--|--|
| 1. $A = \ell \times b$
$\ell = 9 \text{ cm} \times 0,5 = 4,5 \text{ km}$
$b = 2 \text{ cm} \times 0,5 = 1,0 \text{ km}$
$A = 4,5 \text{ km} \times 1,0 \text{ km}$
$= 4,5 \text{ km}^2$ | 2. $A = \ell \times b$
$\ell = 8 \text{ cm} \times 500 = 4\,000 \text{ m}$
$b = 1 \text{ cm} \times 500 = 500 \text{ m}$
$A = 4\,000 \text{ m} \times 500 \text{ m}$
$= 2\,000\,000 \text{ m}^2$ |
| 3. $A = \ell \times b$
$\ell = 2 \text{ cm} \times 0,1 = 0,2 \text{ km}$
$b = 2 \text{ cm} \times 0,1 = 0,2 \text{ km}$
$A = 0,2 \text{ km} \times 0,2 \text{ km}$
$= 0,04 \text{ km}^2$ | 4. $A = \ell \times b$
$\ell = 2 \text{ cm} \times 100 = 200 \text{ m}$
$b = 3 \text{ cm} \times 100 = 300 \text{ m}$
$A = 200 \text{ m} \times 300 \text{ m}$
$= 60\,000 \text{ m}^2$ |

Test Your Understanding 8

(p. 118)

Answers:

1. Gradient = $\frac{VI}{HE}$
 $VI = 554 \text{ m} - 200 \text{ m}$
 $= 354 \text{ m}$
 $HE = 5 \text{ cm} \times 500 = 2\,500 \text{ m}$
 Gradient = $\frac{354}{2\,500} = \frac{1}{7,062} = 1 : 7$
2. Gradient = $\frac{VI}{HE}$
 $VI = 310 \text{ m} - 240 \text{ m}$
 $= 70 \text{ m}$
 $HE = 5,3 \text{ cm} \times 100 = 530 \text{ m}$
 Gradient = $\frac{70}{530} = \frac{1}{7,571} = 1 : 7,6$

**Test Your Understanding 9**

(p. 120)

Answer:

- | | |
|--|---|
| 1. $VE = \frac{VS}{HS}$
$VS: 1 \text{ cm} : 10 \text{ m}$
$\therefore 1 \text{ cm} : 1\,000 \text{ cm}$
$= \frac{1}{1\,000}$
$HS: \frac{1}{50\,000}$
$VE = \frac{\frac{1}{1\,000}}{\frac{1}{50\,000}}$
$= \frac{1}{1\,000} \times \frac{50\,000}{1}$
$= 50$ | 2. $VE = \frac{VS}{HS}$
$VS: 1 \text{ cm} : 30 \text{ m}$
$\therefore 1 \text{ cm} : 3\,000 \text{ cm}$
$= \frac{1}{3\,000}$
$HS: \frac{1}{10\,000}$
$VE = \frac{\frac{1}{3\,000}}{\frac{1}{10\,000}}$
$= \frac{1}{3\,000} \times \frac{10\,000}{1}$
$= 3,3$ |
|--|---|

The vertical exaggeration of the cross section is 50 times.

The vertical exaggeration of the cross section is 3,3 times.

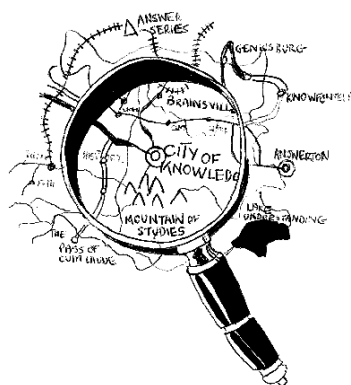
MAPWORK EXAM QUESTIONS

RESOURCE MATERIAL

- *An extract from topographical map 2829AC Harrismith.*
- *Orthophoto map 2829AC3 Harrismith.*

The following English terms and their Afrikaans translations are shown on the topographical map:

English	Afrikaans
Diggings	Uitgrawings
Caravan park	Karavaanpark
Sewage works	Rioolwerke
River mouth	Riviermond
Golf course	Golfbaan
Wetland	Vlei



MULTIPLE CHOICE QUESTIONS

The questions below are based on the 1 : 50 000 topographical map 2829AC HARRISMITH, as well as the orthophoto map of a part of the mapped area. Various options are provided as possible answers to the following questions. Choose the correct answer and write down only the letter (A - D).

- The map projection used on the Harrismith map is the . . . projection.

A Lambert	B Mercator	
C universal transverse	D Gauss conformal	(2)
- The main agricultural activity around Harrismith is . . .

A crop farming	B fruit farming	
C cattle farming	D chicken farming	(2)
- The recreational feature marked **B** on the topographical map is a . . .

A sports field	B swimming pool	
C golf course	D plantation	(2)
- The recreational feature marked **1** on the orthophoto map is a . . .

A park	B nature reserve	
C golf course	D plantation	(2)
- On the orthophoto map the area labelled **7** is an example of a/an . . . residential area.

A high-income	B low-income	
C middle-income	D informal	(2)
- On the topographical map, Phomolong (**A**) in block **A6/7** is an example of a/an . . . residential area.

A high-income	B low-income	
C middle-income	D informal	(2)

7. The index of the topographical map sheet to the southeast of 2829AC Harrismith is . . .
 A 2829CB B 2828DB
 C 2829AB D 2828BB (2)
8. The map index to the south of 2829AC is . . .
 A 2828DB B 2829CA
 C 2828BD D 2829CB (2)
9. Which town is approximately 60 km from Harrismith?
 A Van Reenen B Warden
 C Witsieshoek D Kestell (2)
10. The Sterkfontein Dam is to the . . . of the town of Harrismith.
 A southwest B southeast
 C south D west (2)
11. The river in block **C2** on the topographical map flows in a . . . direction.
 A southeasterly B northeasterly
 C southerly D northwesterly (2)
12. The river in block **F13/14** on the topographical map is in the . . . course.
 A upper B middle
 C lower D upper and middle (2)
13. The drainage pattern in block **A13/14** on the topographical map is . . .
 A trellis B rectangular
 C dendritic D radial (2)
14. The feature labelled **E** on the topographical map is (a) . . .
 A perennial water B non-perennial water
 C marsh and vlei D non-perennial river (2)

15. The N3 is a/an . . .
 A main road
 B arterial route
 C secondary road
 D national route (2)
16. The height of the land at the trig beacon number 299 in block **C9** on the topographical map is . . .
 A 299 m
 B 1 757,2 m
 C 299 km
 D 1 751,2 km (2)
17. The land-use zone numbered **11** on the orthophoto map is the . . . zone.
 A industrial
 B transition
 C residential
 D built-up area (2)
18. The land-use zone numbered **1** on the orthophoto map is a . . .
 A recreational area
 B rural-urban fringe
 C residential area
 D plantation (2)
19. The street pattern of the built-up area in blocks **C1**, **C2** and **D2** on the topographical map is . . .
 A planned irregular
 B a grid
 C unplanned irregular
 D radial (2)
20. The type of slope labelled **3 - 4** on the orthophoto map . . .
 A concave
 B convex
 C terraced
 D uniform steep (2)

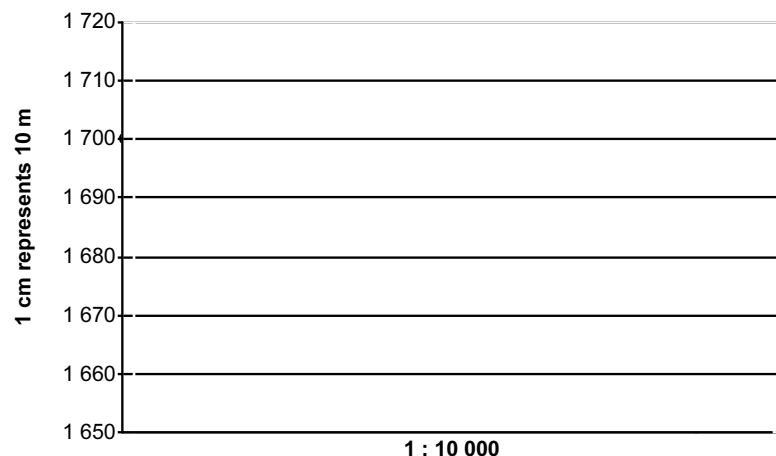


CALCULATIONS AND APPLICATION

QUESTION 1

- 1.1 Calculate the gradient of the slope between spot height 1729 (8) and spot height 1794 (9) on the orthophoto map. (5 × 1) (5)

- 1.2 Refer to the cross section below of the feature labelled Blokhuis (4) on the orthophoto map and answer the questions that follow.

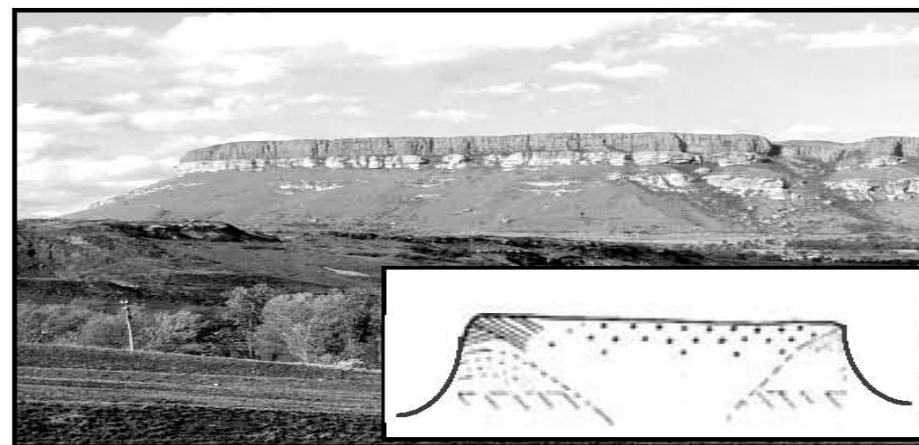


- 1.2.1 Calculate the vertical exaggeration of the cross section marked 2 - 3 on the orthophoto map. (5 × 1) (5)
- 1.2.2 Why is it necessary to exaggerate a cross section vertically? (1 × 1) (1)
- 1.2.3 Identify the feature labelled X on the cross section. (1 × 1) (1)
- 1.3 What is the true bearing of trig beacon 299 from spot height 1731 in block C9 on the topographical map? (1 × 1) (1)
- 1.4 Calculate the area, in square kilometres, of the urban area demarcated by a dark line on the topographical map (blocks A, B, C/7, 8, 9). (4 × 1) (4)
- 1.5 Refer to the orthophoto map.
- 1.5.1 Was this photograph taken before or after midday (12:00)? (1 × 1) (1)
- 1.5.2 Give ONE reason for your answer to Question 1.5.1. (1 × 1) (1)

- 1.5.3 The photograph was most likely taken during a very dry period of the year. Explain this statement with reference to block B7 on the topographical map and the corresponding area on the photograph. (1 × 1) (1)
/20/

QUESTION 2

- 2.1 Harrismith holds an annual marathon that involves contestants running via Platberg. Study both the photograph of Platberg below and the area covered by blocks A/B10, 11, 12 and 13 on the topographical map before answering the questions below.



- 2.1.1 Identify the shape of the slope that the contestants will be running up between points C - D (block A/B10) on the topographical map. Explain your answer with reference to the contour lines on the map. (2 × 1) (2)
- 2.1.2 Calculate the average gradient of the slope between spot height 1797 and spot height 2263 in block A10 on the topographical map. Show ALL calculations. (5 × 1) (5)
- 2.1.3 Comment on the level of difficulty of this slope for a contestant. (1 × 1) (1)
- 2.1.4 Explain why a zig-zag footpath (block A11) has been cut over Platberg. (1 × 1) (1)
- 2.1.5 Sometimes, during winter nights, the temperature drops to below freezing point in Harrismith. Explain how Platberg possibly influences the temperature. (2 × 2) (4)

2.2 Identify the following fluvial features in block **D6**:

2.2.1 **D**

(1 × 2) (2)

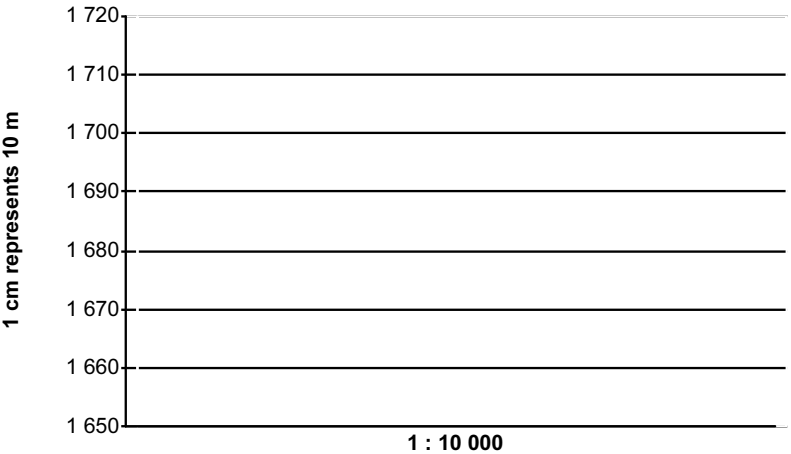
2.2.2 **E**

(1 × 2) (2)

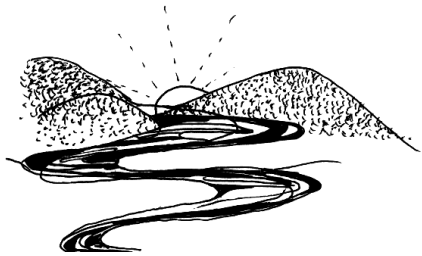
2.3 Using the information on the topographical map, determine the magnetic declination for 2014. Show ALL calculations/steps followed.

(4 × 1) (4)

2.4 Refer to the feature labelled Blokhuis (4) on the orthophoto map. Draw a cross section of the feature from 2 to 3 on the axes below.



(12 × $\frac{1}{2}$) (6)
/27/

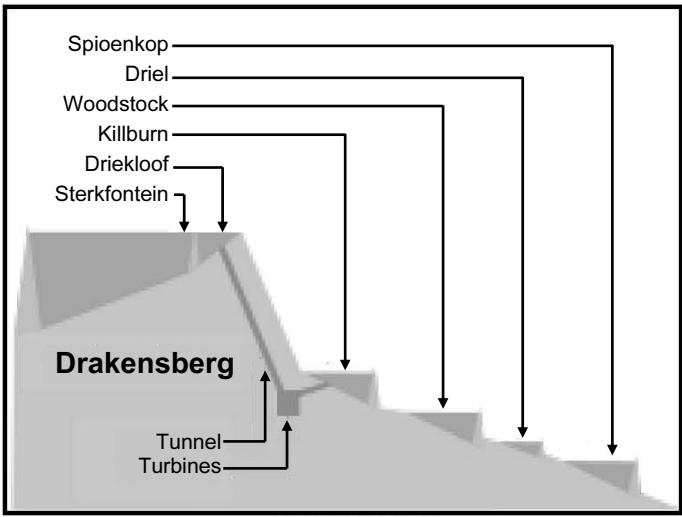


APPLICATION AND INTERPRETATION

QUESTION 1

1.1 The Sterkfontein Dam forms an important part of the Tugela-Vaal Scheme. Refer to the diagram below (Figure 1.1) as well as the dam on the topographical map to answer the questions that follows.

FIGURE 1.1



- 1.1.1 Describe the difference in position of the Sterkfontein Dam in relation to the Spioenkop, Driel, Woodstock and Killburn Dams. (1 × 2) (2)
- 1.1.2 The Sterkfontein Dam has an ideal location for the storage of water. Give ONE reason to support this statement. (1 × 2) (2)
- 1.1.3 Name TWO ways in which the residents of Harrismith and its surrounding area can benefit from the Sterkfontein Dam. (2 × 2) (4)
- 1.2 Harrismith is located in a low-rainfall area. Give TWO pieces of evidence from the map to support this statement. (2 × 2) (4)
- 1.3 Identify the drainage pattern in blocks **E/F3**, **4** and **5** and give evidence from the map to support your answer. (2 × 2) (4)

- 1.4 Refer to Nuwejaarspruit in block **G2** on the topographical map.
- 1.4.1 Is this a perennial or non-perennial river? (1 × 2) (2)
- 1.4.2 Nuwejaarspruit is in its middle course, changing to the lower course. Give TWO pieces of evidence from the map to support this statement. (2 × 2) (4)
- 1.5 Harrismith is a very old town that developed in the colonial era. Support this statement with ONE piece of evidence from the map. (1 × 2) (2)
- 1.6 Refer to the dominant primary activity practiced in blocks **H1** and **H2**.
- 1.6.1 Identify the dominant primary activity referred to above. (1 × 2) (2)
- 1.6.2 Explain how the environment is likely to be affected by this activity identified in Question 1.6.1 in a negative way. (1 × 2) (2)
- 1.7 Refer to the N3.
- 1.7.1 Why does the N3 NOT pass through Harrismith? (2 × 2) (4)
- 1.7.2 What is the disadvantage for businesses of the N3 not passing through Harrismith? (1 × 2) (2)
- 1.8 Refer to Wilgerpark on the orthophoto map.
- 1.8.1 Wilgerpark developed much later than the original town of Harrismith. Give ONE reason from the orthophoto map to support this statement. (1 × 2) (2)
- 1.8.2 Wilgerpark is a high-income residential area. Give ONE piece of evidence from the topographical map to support the answer. (1 × 2) (2)
- 1.8.3 Give ONE disadvantage of the location of Wilgerpark. (1 × 2) (2)

QUESTION 2

- 2.1 Refer to the industrial area in block **B/C2**.
- 2.1.1 Is this likely to be a heavy or a light industrial area? Give a reason for your answer. (2 × 2) (4)
- 2.1.2 Give TWO factors that would have favoured its location in this area. (2 × 2) (4)
- 2.2 The sewage works is located in block **B6**.
- 2.2.1 Name the land-use zone in which the sewage works is located. (1 × 2) (2)
- 2.2.2 Comment on the suitability of its location. (1 × 2) (2)

- 2.3 Refer to the farm named Rockydale in block **E10**.
- 2.3.1 Identify the type of commercial farming practised at Rockydale. (1 × 2) (2)
- 2.3.2 Irrigation is important to farming on Rockydale. Name TWO sources of water available to them. (2 × 2) (4)
- 2.3.3 What is the purpose of the row of trees along the edge of the cultivated land? State TWO purposes. (2 × 2) (4)
- 2.4 Refer to street patterns and answer the questions that follow.
- 2.4.1 Identify the street pattern at Wilgerpark. (1 × 2) (2)
- 2.4.2 State ONE advantage and ONE disadvantage of the street pattern in Wilgerpark. (2 × 2) (4)

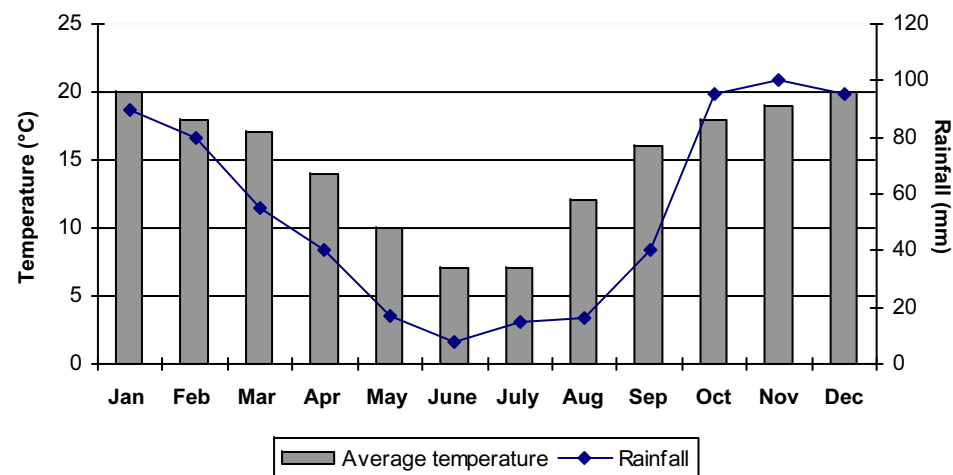
/28/

GEOGRAPHICAL INFORMATION SYSTEMS (GIS)

QUESTION 1

- 1.1 Explain the meaning of the term *spatial data*. (1 × 2) (2)
- 1.2 State the spatial data allocated for Harrismith. (1 × 2) (2)
- 1.3 Study the bar graph below which depicts temperature and rainfall data for Harrismith. A statistical analysis of the data on the graph will be useful for farmers. The bar graph is an example of attribute data.

Average temperature and rainfall for Harrismith



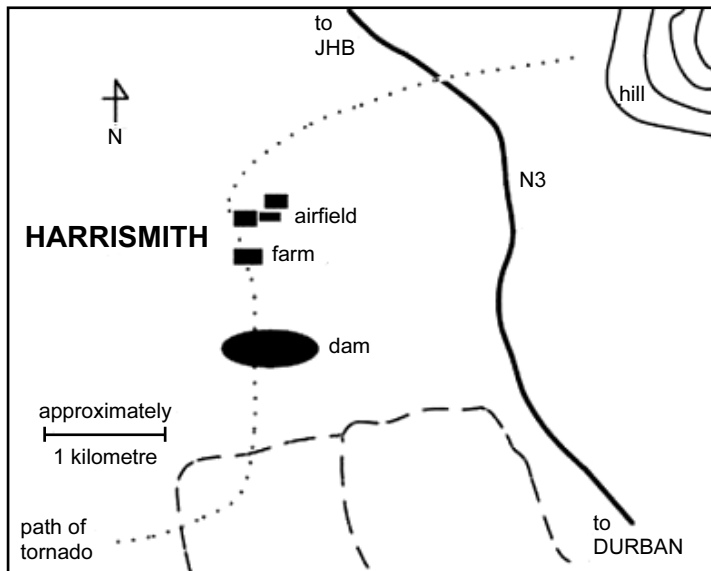
- 1.3.1 What is *attribute data*? (1 × 2) (2)
- 1.3.2 Give ONE attribute provided by the bar graph. (1 × 2) (2)
- 1.3.3 Explain how you can use the attributes provided by the bar graph. (2 × 2) (4)
- 1.4 Refer to the orthophoto map which shows a high spatial resolution.
- 1.4.1 Explain the term *spatial resolution*. (1 × 2) (2)
- 1.4.2 Why can one say that the orthophoto map has a high spatial resolution? (1 × 2) (2)
- 1.5 How can GIS assist city planners to determine where a new shopping centre can be built in Harrismith? (2 × 2) (4)

/20/

QUESTION 2

- 2.1 Study the map below (Figure 2.1) which shows the path of the tornado that tore through Harrismith a few years ago. Many data layers were used to draw this map.

FIGURE 2.1



[Source: Goliger en Van Wyk]

- 2.1.1 Define the term *data layering (overlaying)*. (1 × 2) (2)
- 2.1.2 Name TWO data layers visible on the map (Figure 2.1). (2 × 2) (4)
- 2.1.3 GIS is useful in disaster management. Explain how it would have assisted the local authorities with planning after the tornado struck. (2 × 2) (4)

/14/

- 2.2 Study the photo (Figure 2.2) of the N3 that bypasses Harrismith and connects Durban and Johannesburg.

FIGURE 2.2



[Source: Google]

- 2.2.1 Differentiate between *spatial data* and *attribute data*. (2 × 2) (4)
- 2.2.2 What type of spatial object (point, line or polygon) is on the road? (1 × 2) (2)
- 2.2.3 Give ONE attribute that can be captured for the N3. (1 × 2) (2)
- 2.3 If a vehicle with a global positioning system (GPS) approaches Harrismith, how can the GPS assist the driver to find the hospital numbered 10 on the orthophoto map? (1 × 2) (2)

/20/

QUESTION 3

- 3.1 What does the term *data layering* mean? (1 × 2) (2)
- 3.2 Name any TWO layers of information that one can identify in block G3 on the topographical map. (2 × 2) (4)
- 3.3 State TWO uses of data layering in GIS. (2 × 2) (4)
- 3.4 Explain the meaning of the following terms:
- 3.4.1 Buffering (1 × 2) (2)
- 3.4.2 Querying (1 × 2) (2)

/14/