SENIOR SECONDARY INTERVENTION PROGRAMME 2013

education
Department: Education
GAUTENG PROVINCE

GRADE 12

GEOGRAPHY

LEARNER NOTES

The SSIP is supported by

TABLE OF CONTENTS

LEARNER NOTES

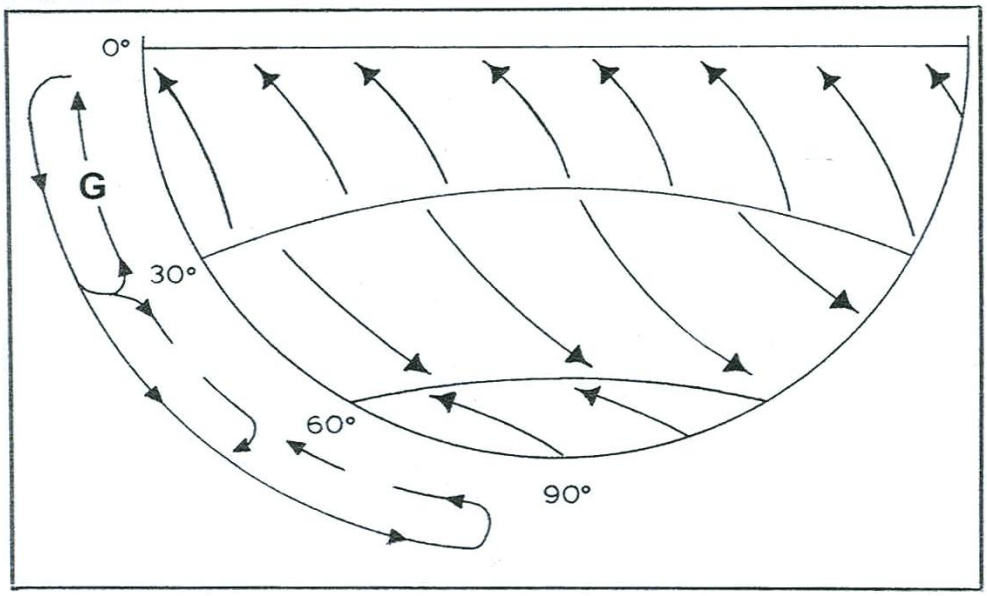
TOPIC 1: CLIMATE AND WEATHER - SA AND THE WORLD: CHANGE IN ENERGY BALANCE – THE DEVELOPMENT OF WINDS AND GLOBAL CIRCULATION

Learner Note: You need to understand why winds develop, how temperature difference and air pressure causes winds on earth. The following work on SA weather and cyclones can only be understood well if you know more about how winds are formed. You need to spend more time on topic 1 than topic 2

SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: Global Circulation **5 minutes** **10 marks** *(DoE November 2008)*

FIGURE 1.1 FIGUUR 1.1



QUESTION 1

1.1 Refer to FIGURE 1.1. Four options are provided as possible answers to the following questions. Choose the answer and write only the letter (A – D) next to the question number (1.1.1 – 1.1.5), for example 1.1.6 A.

1.1.1 Identify the cell labelled **G** which occurs between 0° – 30° north and south of the equator.

A Hadley
B Ferrell (mid-latitude)
C Polar
D Equatorial

1.1.2 The area near the equator where the winds die out is referred to as the …

A polar front.
B inter-tropical convergence zone (ITCZ).
C doldrums.
D inter-tropical front.

1.1.3 Winds associated with the ITCZ are …

A southeast trades.
B southeast and northeast trades.
C northwesterlies and southwesterlies.
D polar easterlies

1.1.4 A force that influences the speed of winds is called the …

A pressure gradient force.
B Coriolis force.
C geostrophic force.
D primary force.

1.1.5 Air rises at the equator and sinks at the poles due to …

A divergence at the equator and convergence at the poles.
B divergence at the poles and convergence at the equator.
C surplus heat at the equator and a heat deficit at the poles.
D surplus heat at the poles and a heat deficit at the equator (5 x 2) [10]

HINTS

Hint 1: Never leave out questions – especially not multiple choice questions.
Hint 2: Number correctly and write only the correct letter next to the number, e.g. 1.1.5 C
Hint 3: Never write down two answers. If you do, you will get no marks.

QUESTION 2: 15 minutes 22 marks *(Adapted from: DoE March 2009)*

Refer to figure below showing the global distribution of the earth's pressure belts, planetary wind belts and the tri-cellular circulation of air and answer the questions that follow. The planetary wind system is the result of the Coriolis force which causes air to deflect.

2.1 (a) What is responsible for the existence of the Coriolis force? (1 x 2) (2)

(b) How does the strength of the Coriolis force change from the equator to the poles? (1 x 2) (2)

(c) Explain how the Coriolis force results in the planetary wind belts as illustrated in the figure below. (2 x 2) (4)

2.2 (a) Identify the planetary wind belts labelled A and B respectively. (2 x 2) (4)

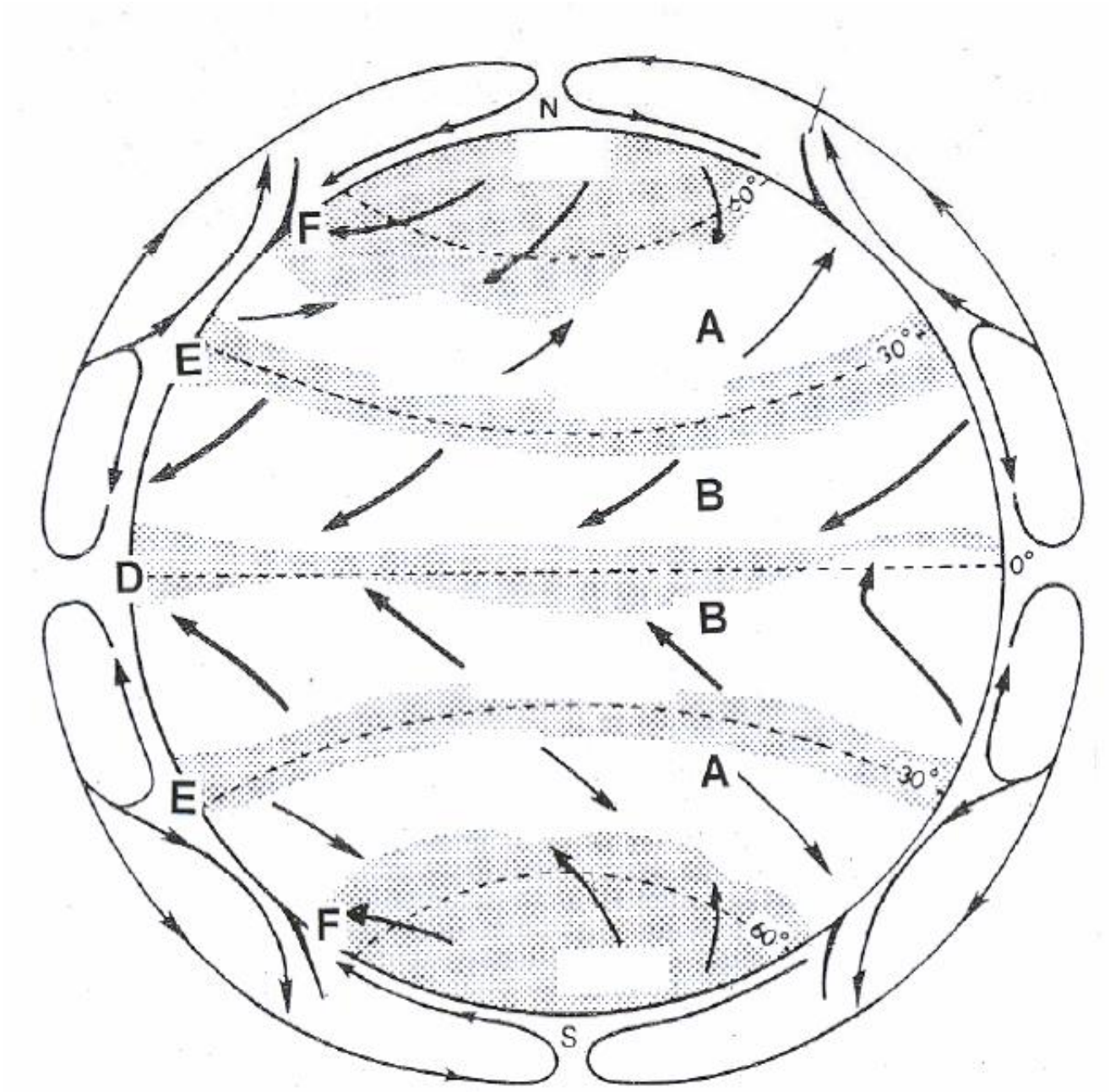
(b) In which ONE of the planetary wind belts mentioned in QUESTION 2..2(a) do mid-latitude cyclones develop? (1 x 2) (2)

(c) Taking your answer to QUESTION 2.2(b) into account, give the general direction of movement of a mid-latitude cyclone (1 x 2) (2)

2.3 (a) At which position, D, E or F, does one expect to find convectional thunderstorms? (1 x 2) (2)

(b) Explain your answer to QUESTION 2.3(a). (2 x 2) (4)

[22]



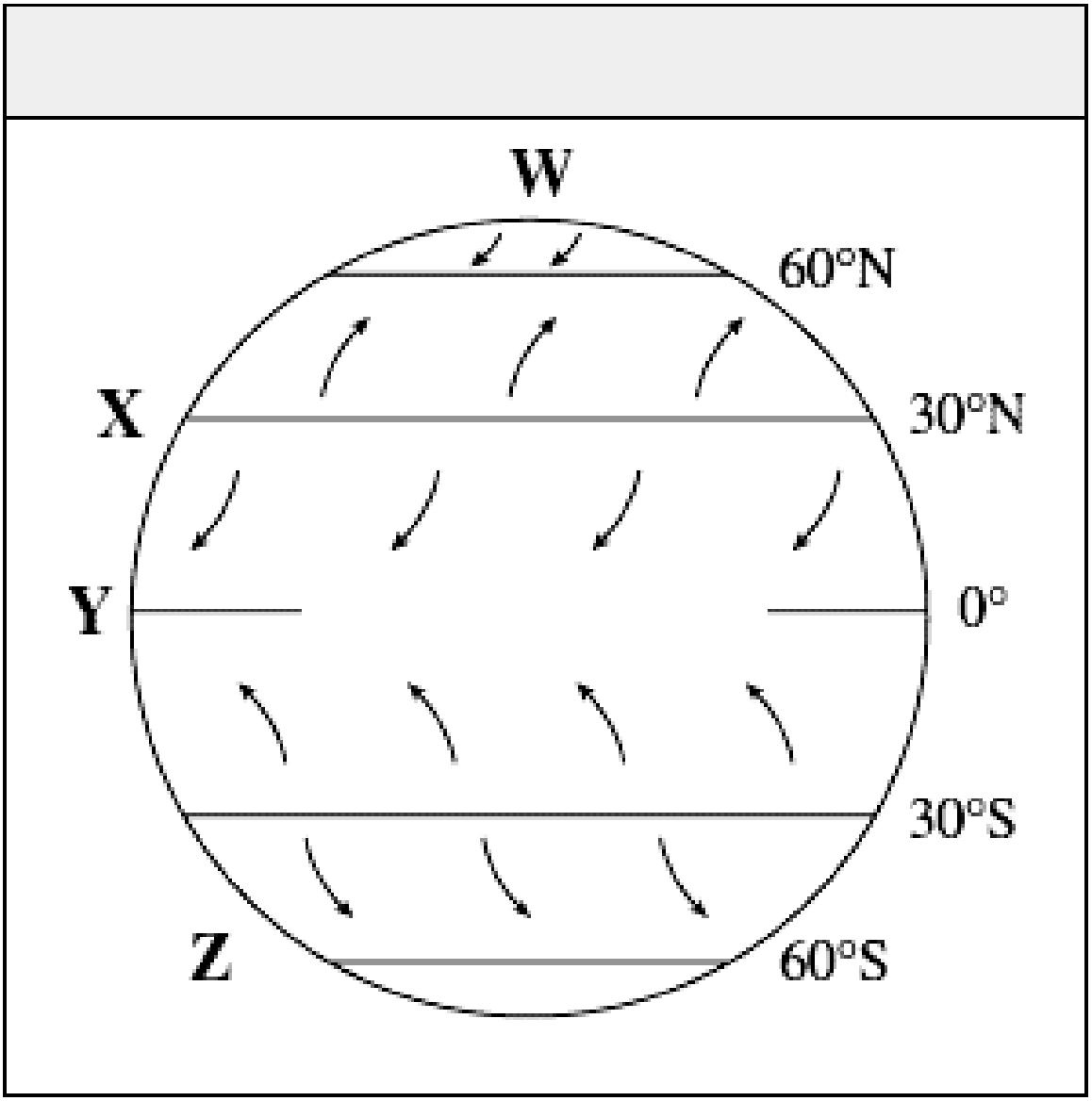
HINTS:

Hint 1: You need to know the sketch above off by heart and must be able to label all the wind belts and pressure belts as well as the ITCZ and polar fronts.

Hint 2: You need to explain how these winds blow and understand how the system works.

Hint 3: Do not confuse wind belts and pressure belts. If you are asked for a pressure belt and you give a wind belt as an answer, you will not get marks.

QUESTION 3: 5 minutes 10 marks *(Adapted from: DoE November 2010)*



3.1 Refer to the figure above showing global pressure belts and winds. Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A – D) next to the question number.

3.1.1 FIGURE 1.1 illustrates … circulation.

A primary
B secondary
C tertiary
D upper atmospheric

3.1.2 Convergence occurs in this area to form the ITCZ:

A W
B X
C Y
D Z

3.1.3 The westerlies and polar winds converge here to form the polar front:

A W
B X
C Y
D Z

3.1.4 The northwesterlies diverge from this pressure belt:

A W
B X
C Y
D Z

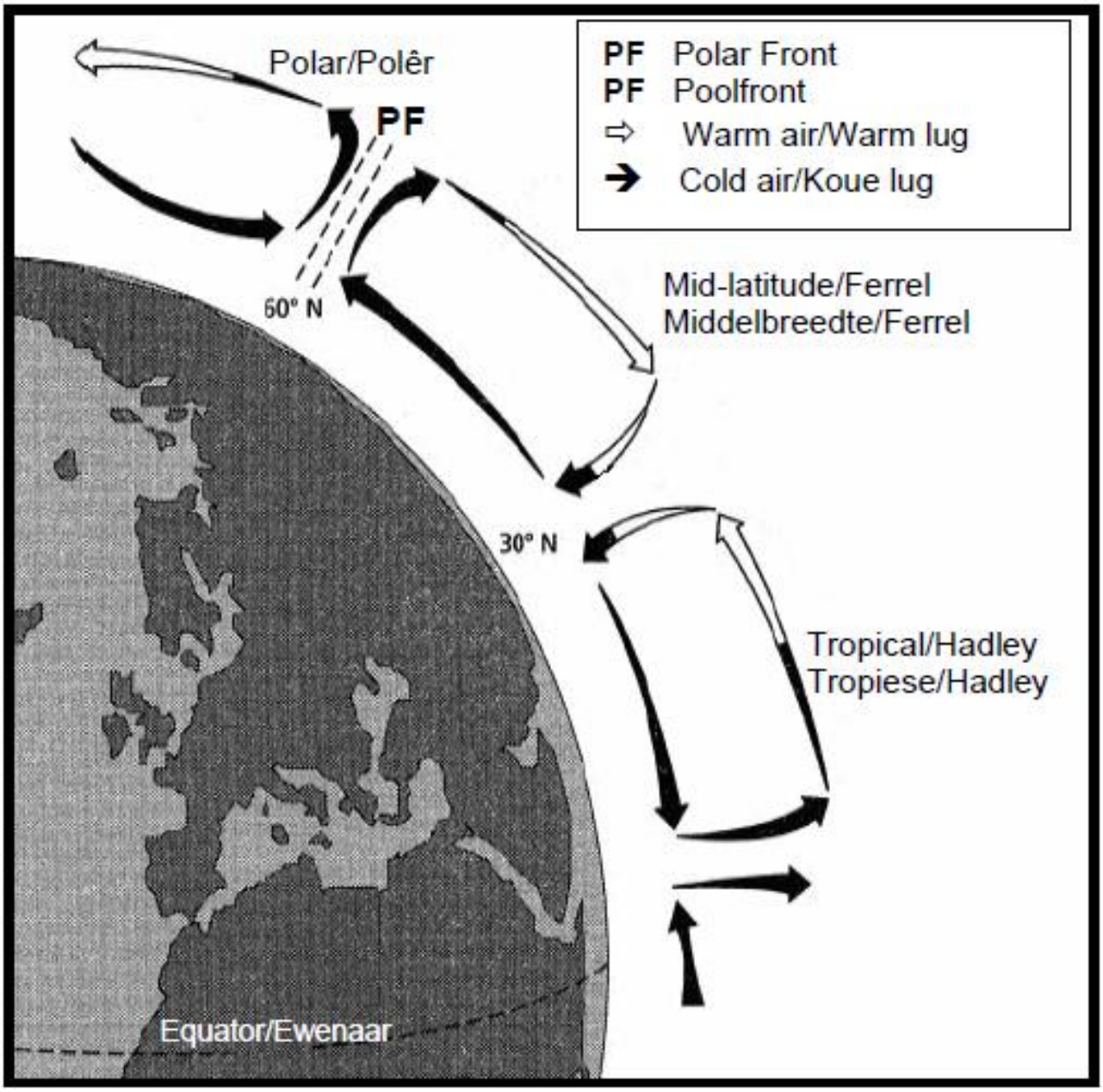
3.1.5 This area is associated with the origin of the polar easterlies:

A W
B X
C Y
D Z (5 x 2) [10]

QUESTION 4: 5 minutes 10 marks *(Adapted from: DoE November 2010)*

Refer to the figure below showing the tri-cellular arrangement of atmospheric circulation. Match each statement below with the Hadley/tropical, Ferrell/mid-latitude or polar cell.

4.1.1 Convergence of surface air causes uplift along the equator.
4.1.2 Occurs between 60° – 90° N of the equator.
4.1.3 Air in the upper atmosphere is heated as it moves towards the equator.
4.1.4 This is a heat-generated cell of circulation.
4.1.5 Develops on the northern side of the polar front. (5 x 2) [10]



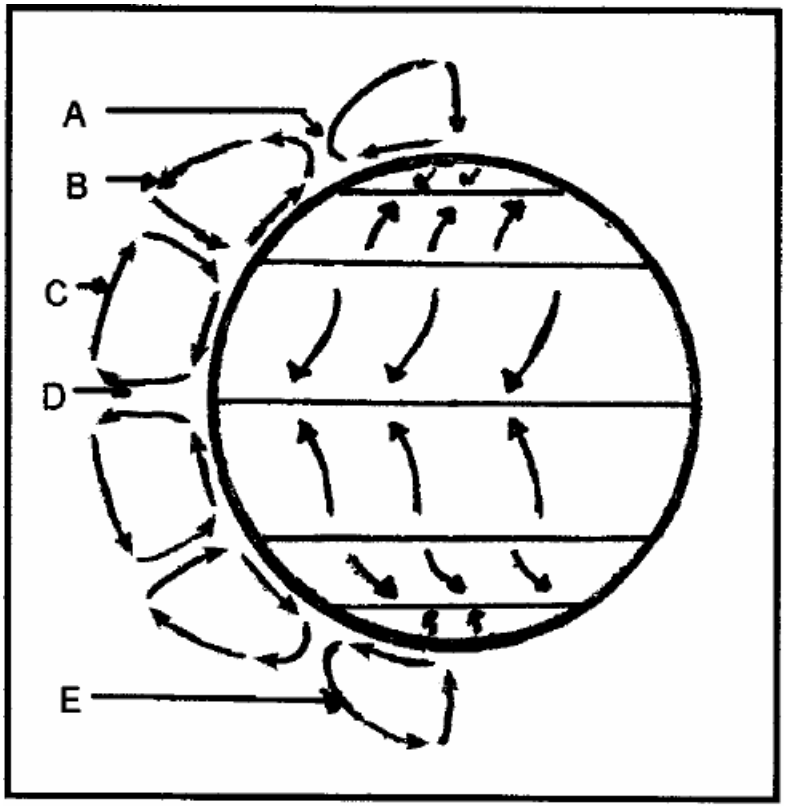
HINTS

Hint 1: Read the question carefully and match it with the feature that fits the description best.

Hint 2: You have a choice of three answers for each question – given in the question – so all the answers must be either Hadley/Tropical or Ferrell/Mid latitude or polar cell.

QUESTION 5: 5 minutes 10 marks *(Adapted from: DoE September 2008)*

5.1 Refer to the figure below showing the tri-cellular arrangement of the atmosphere. Various options are provided as possible answers to each of the following questions. Choose the answer and write only the letter (A – D) next to the question number



5.1.1 The front at A is known as the … front.

A tropical
B mid-latitude
C polar
D moisture

5.1.2 The air circulation cell labelled B is the … cell.

A Hadley
B Ferrell
C polar
D tropical

5.1.3 The surface air flow in the air circulatory cell labelled C is …

A convergence.
B divergence.
C uplift.
D subsidence.

5.1.4 The … winds meet at D.

A polar easterly
B tropical easterly
C polar westerly
D tropical westerly

5.1.5 At E there is a general … of air.

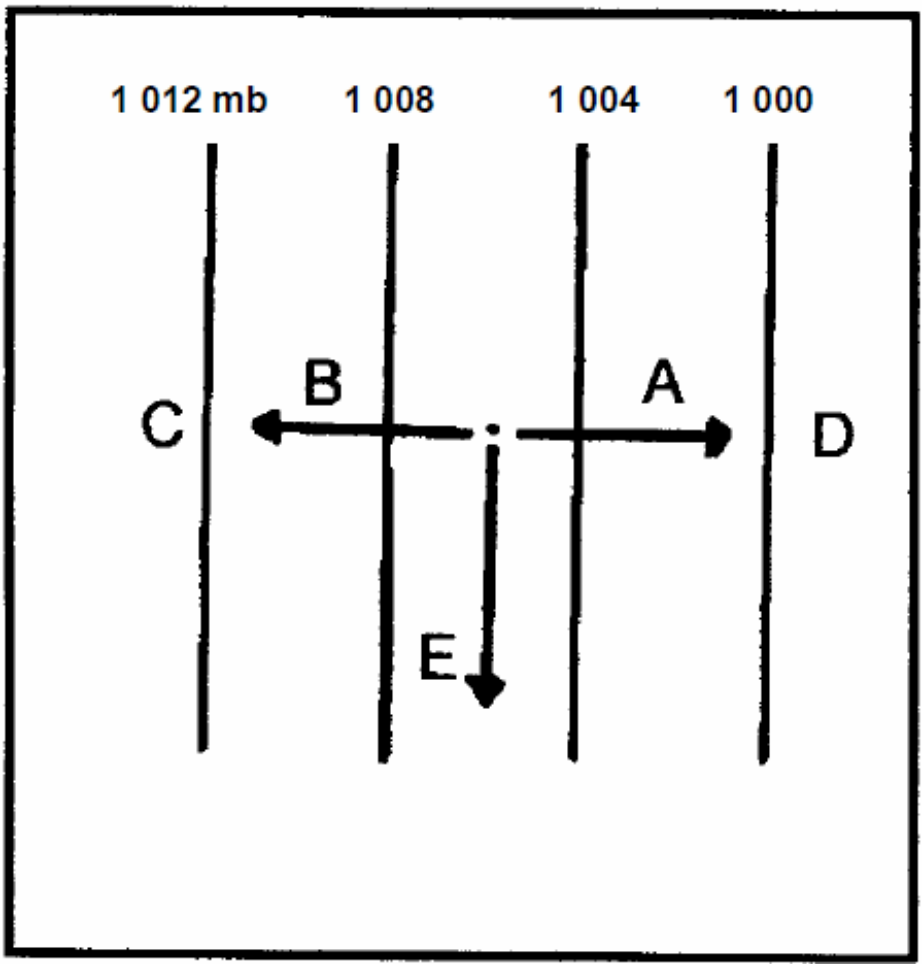
A subsidence and heating
B rising and heating
C subsidence and cooling
D rising and cooling (5x2) [10]

QUESTION 6: 10 minutes 10 marks *(Adapted from: DoE September 2008)*

6.1 Refer to FIGURE 2.1 showing the deflection of winds. Match each of the letters **A**, **B**, **C**, **D** and **E** with ONE of the terms listed below. Write down only the letter (A – E) and next to it the correct term, for example G – Pressure cell.

- High pressure area
- Frictional force
- Low pressure area
- Convergence
- Geostrophic wind
- Pressure gradient force
- Coriolis force (5x2) [10)]

FIGURE 2.1



SECTION B: CONTENT KNOWLEDGE IN ENERGY BALANCE AND GLOBAL WINDS

1. INTRODUCTION

Primary circulation or global circulation explains how the circulation occurs over the whole globe. This circulation has an influence on climate worldwide and in smaller regions. The global circulation cells are set in motion by temperature differences over the surface of the earth which leads to air pressure differences, and winds that develop on the surface.

2. AIR PRESSURE

Air pressure is caused by the gravity of the earth. Temperature causes differences in pressure. If there are high pressure and low pressure areas in the atmosphere, pressure gradient develops. Winds balance the imbalances in pressure by moving molecules from high pressure concentrations to low pressure areas.

2.1. AIR PRESSURE AND TEMPERATURE

Air pressure is influenced by altitude – the higher you go the lower the air pressure. The lower air pressure also influences the temperature as there is less each of the various gasses to trap heat. The temperature drops with an increase in altitude. This is called a positive temperature lapse rate. The normal or environmental temperature lapse rate in the troposphere is 0,65ºC/100m in stable air masses. Pressure varies vertically and horizontally. This is caused by temperature difference on the surface.
Air will stay stable where there is a balance between the low pressure in the upper air and the force of gravity. This is called hydrostatic balance.

If there is an imbalance in pressure, winds will equal it out by blowing from a high pressure area to a low pressure area. Stable air does not move. Unstable air moves.

2.2. RISING AND SUBSIDING AIR.

What happens when air rises? When air is heated, the molecules will move faster and cover larger spaces. The air becomes less dense than the surrounding air and starts to rises. The air needs energy to fill a larger space. Latent air is used to expand, and the air cools down at Dry Adiabatic Lapse Rate (D.A.L.R.) 1ºC/100m.

When air cools down it loses its ability to hold moisture and the humidity increases. The air mass becomes saturated and reaches dew point temperature. Condensation takes place, clouds form and precipitation can occur. When condensation takes place, latent heat is released and the air mass only cools down at 0,5ºC/100m (Wet Adiabatic Lapse Rate – W.A.L.R.)

2.3. GLOBAL PRESSURE BELTS AND RESULTANT WINDS

The earth is not heated equally everywhere by the sun. The equator receives more direct sunlight and is warm. As one moves way from the equator, the sunlight falls in at a larger angle and becomes less concentrated. This causes the poles to be much colder than the equator. These different temperatures lead to low pressure cells where it is hot, and high pressure cells where it is colder or where air sub sides because it has cooled. These LP and HP cells lead to the development of the primary wind belts. See the sketch on the next page.

High Pressures	Low Pressures
■ Air subsides ■ Air heats up at D.A.L.R. Dry adiabatic lapse rate of 1ºC/100m ■ Air becomes drier ■ Clear skies and no cloud formation ■ Temperature inversion can develop where the subsiding air becomes warmer than the air on the surface	■ Air ascends (rises) ■ Air cools down at D.A.L.R. 1ºC/100m and becomes saturated and reaches dew point temperature. ■ Condensation takes place ■ Latent heat is released during condensation ■ Air cools further at W.A.L.R. Wet Adiabatic lapse rate of 0,5ºC/100m ■ clouds form and precipitation occur

2.4. GLOBAL CIRCULATIONS CELLS

2.5.1. THE HADLEY OR TROPICAL CELL

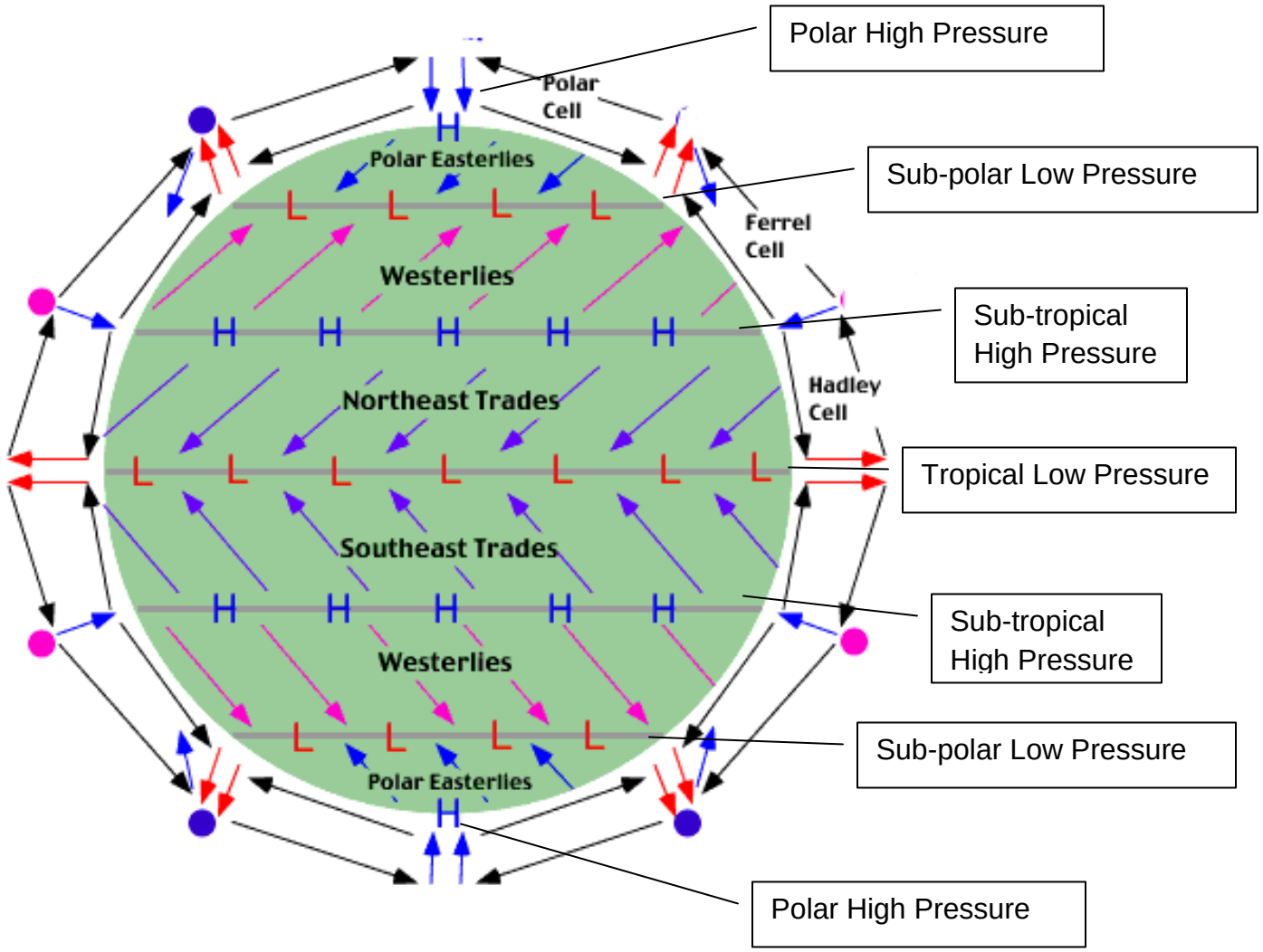
Air rises at the Inter Tropical Convergence Zone (ITCZ) due to the high temperatures at the equator. The area on the surface is called the Doldrums. This is an area where very little wind occurs as there is lots of convection but little advection (horizontal movement of air).
The air cools down to reach d.p.t. and condensation takes place. Clouds form and tropical rain occurs from these clouds. The upper air diverges and sinks at 30º North and South. Owing to the rising air, a low pressure area develops at the equator, and owing to the subsidence at 30º North and South, the sub-tropical high pressure cells develop there. Wind blows from the sub-tropical high pressure cells to the tropical low pressure cells. These winds are deflected by Coriolis force and develop as south easterly winds and north easterly winds in the respective hemispheres. Refer back to the table that describes weather at high pressure and low pressure areas.

2.4.2. FERREL CELLS

Air is forced up at the polar fronts (60º north and south) and forms the sub-polar low pressure cells. Air circulates and sinks at the 30º North and South at the sub-tropical high pressure cells. The westerly winds form between the sub tropical high pressure cells and the sub-polar low pressure cells. The Westerlies are also deflected by Coriolis force.

2.4.3. THE POLAR CELLS

An intense high pressure develops at the poles due to the very cold conditions. The air moves away from the high pressure as Polar Easterly winds (deflected by Coriolis winds) to the sub-polar low pressure areas. Upper air is drawn to the Polar High pressure.

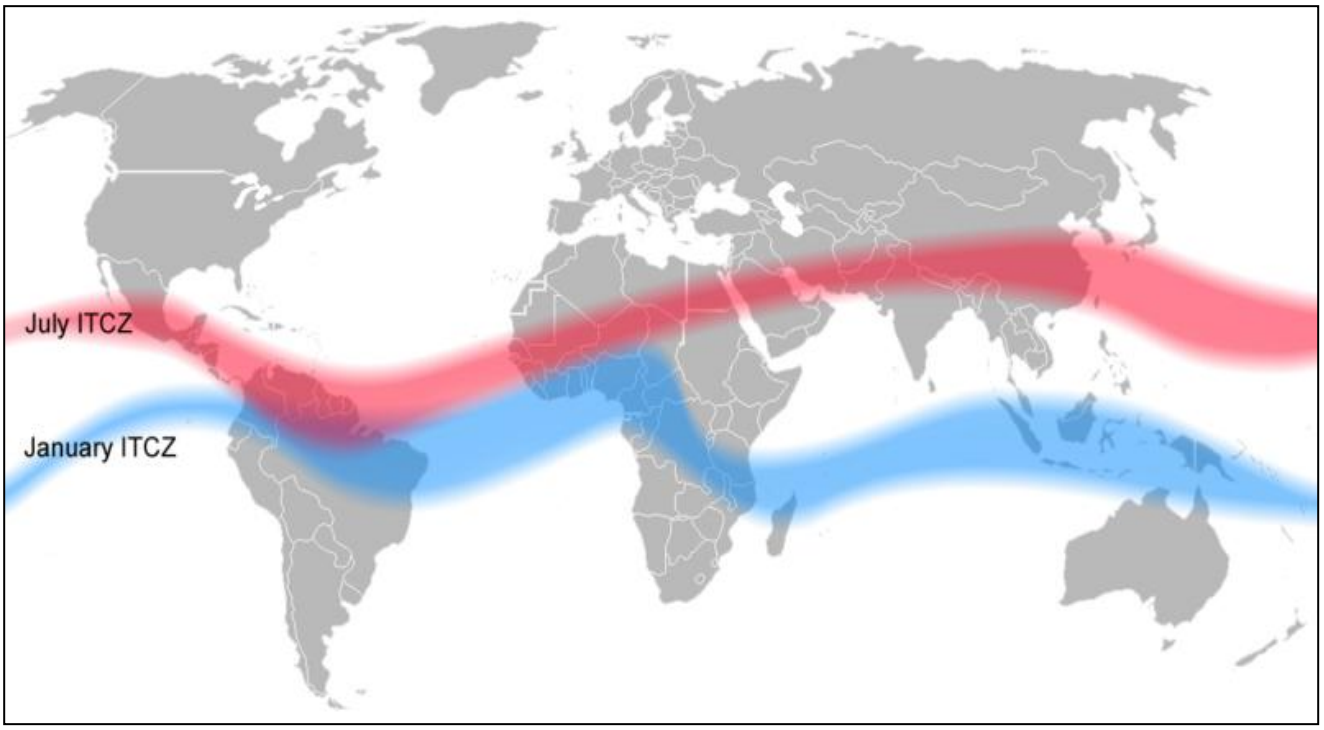


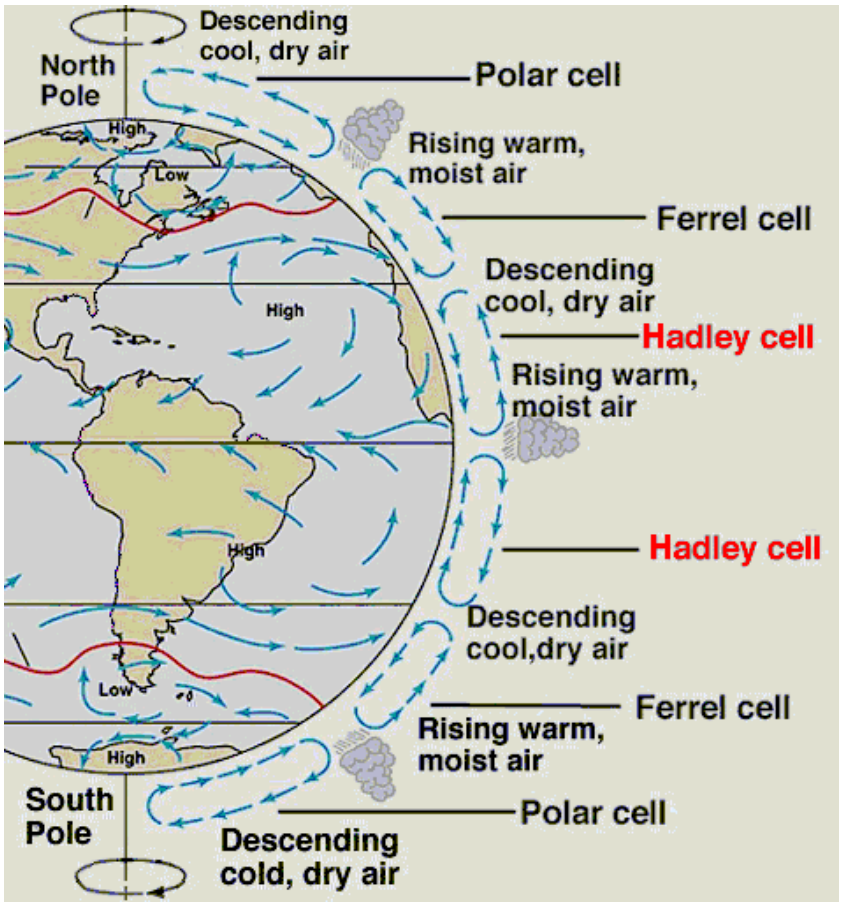
3. THE HEAT EQUATOR

The direct sunlight moves between the tropics as the seasons change. The ITCZ follows the warmest area – Heat Equator. All of the global circulation cells move with the direct sunlight and the equator. In summer South Africa has the tropical easterly winds blowing over the country causing moist air to enter the country and summer rain.

In winter the sub-tropical high pressure belts cause clear dry weather over the interior and the Western Cape and Southern Cape experience mid-latitude cyclones that move with the westerly wind over the south of the country. The Cape then experiences frontal winter rain.

The map illustrates the shifting Heat Equator caused by the shifting direct sunlight





SECTION C: HOMEWORK

TOPIC 1:

QUESTION 1: 10 minutes 20 marks

Indicate whether the following questions are true or false:

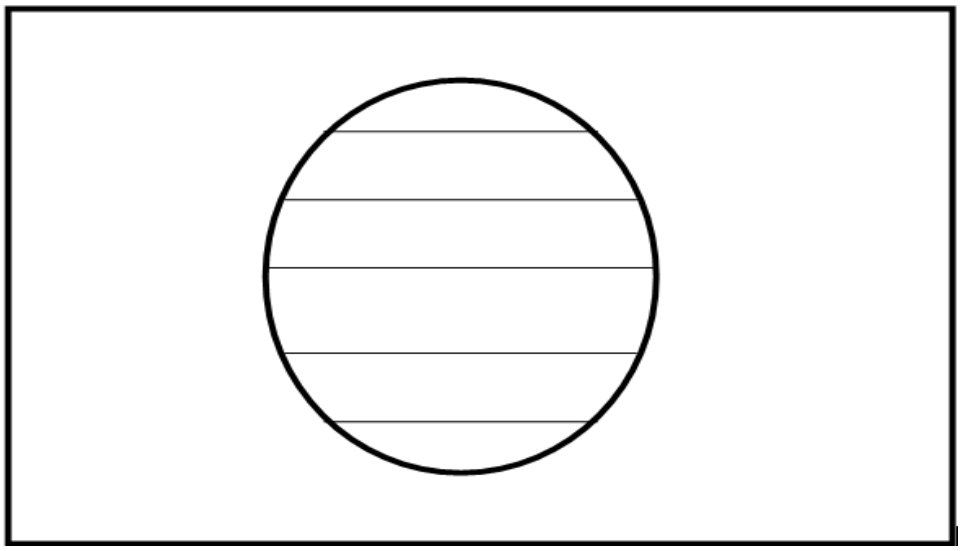
1. Primary circulation cells are set in motion by winds
2. The Ferrell cell is thermally driven.
3. Coriolis force is caused by the different rotation speeds at different latitudes.
4. Coriolis force is absent at the equator.
5. Coriolis force deflects winds to the left of their original direction, the Southern hemisphere.
6. Air move clockwise away from a low pressure in the southern hemisphere.
7. High pressure cells are associated with clear dry weather, because there is rising air.
8. Clouds can only form in rising air.
9. The polar front is at 90º North and South.
10. The global circulation cells are not completely stable. (10 x 2) [20]

QUESTION 2: Global Circulation and Winds 1 hour 50 marks

2.1. Label the sketch below to illustrate the following information about global circulation:

2.1.1. Indicate the global circulation cells. (3)
2.1.2. Indicate all the air pressure belts. (7)
2.1.3. Draw in and label all the wind belts. (6)
2.1.4. Indicate where the ITCZ / Doldrums and the polar fronts occur. (3)

Global Circulation



2.2. What sets the global circulation cells in motion? (2)

2.3. Explain with a well labelled sketch why the air ascends at the I.T.C.Z. (5)

2.4. Explain what happens at the Doldrums. (3)

2.5. Describe the air movement at the sub-tropical high pressure cells in the southern hemisphere. (3)

2.6. Which two air masses meet at the polar fronts? (2)

2.7. Explain how the heat equator influence the positioning of the primary circulation cells during a year. (4)

2.8. Why can tropical cyclones not develop on the equator? (1)

2.9. Where do mid-latitude cyclones start? (1)

2.10. Explain how Coriolis force influence wind in the southern and northern hemispheres respectively. (2)

2.11. Explain how upper air divergence influences the convection at the equator. (2)

2.12. Describe what happens to descending air.
Refer to temperature, humidity and air pressure. (3)

2.13. Describe what happens to unstable air. (3)
[50]

SECTION D: SOLUTIONS AND HINTS TO SECTION A

QUESTION 1

1.1.1 A √√ Hadley

1.1.2 C √√ Doldrums **OR**
B √√ inter-tropical convergence zone (ITCZ) 2

1.1.3 B √√ southeast and northeast trades

1.1.4 A √√ pressure gradient force

1.1.5 C √√ surplus heat at the equator and a deficit at the poles **(5x2) [10]**

QUESTION 2

2.1 (a) Rotation of the earth √√ (1 x 2) (2)

(b) Strengthens/get stronger √√ (1 x 2) (2)

(c) Air moves from HP to LP √√
Coriolis force results in air being deflected to left in S hemisphere and right in N hemisphere √√ (2 x 2) (4)

2.2 (a) A – westerlies √√
B – tropical easterlies/trade wind belt √√ (2 x 2) (4)

(b) A – westerlies √√ (1 x 2) (2)

(c) West to east/eastwards √√ (1 x 2) (2)

2.3 (a) D√√ (1 x 2) (2)

(b) Extremely warm air at equator / high temperature √√
Warm air rises rapidly to great altitudes / heights √√
Large scale condensation results in thunderstorms √√ [Any TWO] (2 x 2) (4)

[22]

QUESTION 3

3.1.1 A/B √√
3.1.2 C √√)
3.1.3 D √√
3.1.4 B √√
3.1.5 A √√ **(5 x 2) [10]**

QUESTION 4

4.1.1 Hadley/Tropical √√
4.1.2 Polar cell √√
4.1.3 Ferrell/Mid-latitude √√
4.1.4 Hadley/Tropical √√
4.1.5 Polar √√ **(5 x 2) [10]**

QUESTION 5

5.1.1 C √√
5.1.2 B √√
5.1.3 B √√
5.1.4 B √√
5.1.5 A √√ **(5 x 2) [10]**

QUESTION 6

6.1 A – Pressure gradient force √√)
B – Coriolis force √√
C – High-pressure area√√
D – Low-pressure area √√
E – Geostrophic flow (wind) √√

(5x2) [10]

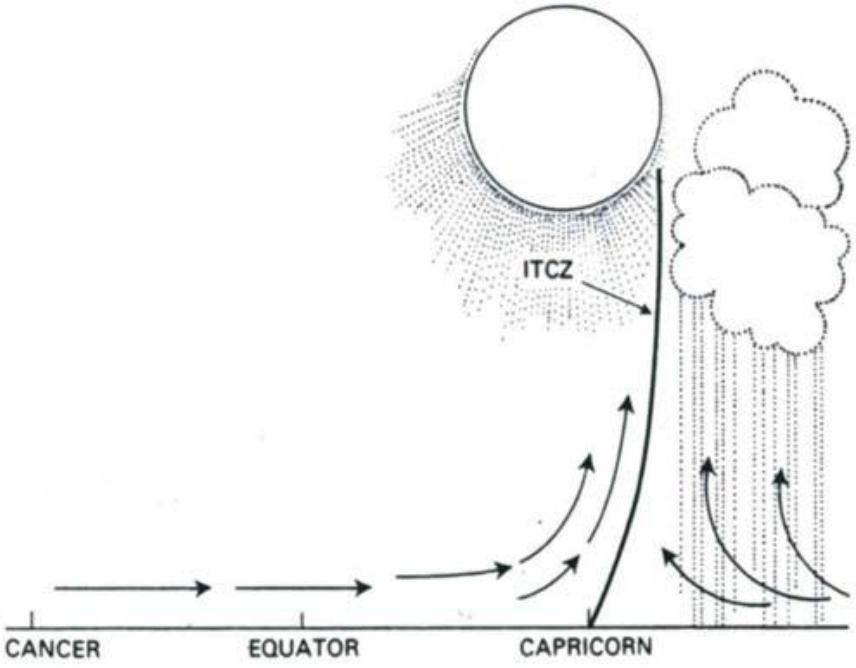
TOPIC 2: SECONDARY AND TERTIARY CIRCULATION

Learner Note: To be able to understand the mid-latitude and tropical cyclones, you need to know primary circulation very well. Primary circulation was dealt with in Session 1 Topic 1. Primary refers to global circulation which explains how global wind and pressure belts form and behave. Secondary circulation refers to the wind and pressure in specific areas. In other words, we zoom in to just look at what is happening in the middle latitudes (30 – 60°N and S). We will also zoom in on the tropics and look at the formation of tropical cyclones in the next session. Lastly, we will zoom in on the high pressure cells that form part of the sub-tropical high pressure belt, which influence the weather of South Africa in a next session. Tertiary circulation refers to local climate like valley conditions, coastal conditions and urban climates which will also be dealt with in later session.

SECTION A: TYPICAL EXAM QUESTIONS ON SECONDARY & TERTIARY CIRCULATION

The first question refers to Global or Primary Circulation.

QUESTION 1: 10 minutes 16 marks *(Source: Sunday Times Practice Paper November 2009)*



1.1. Use the figure on the following page to answer this question. The figure shows a cross section of the ITCZ.

1.1.1 What do the letters ITCZ stand for? (1 x 2) (2)

1.1.2 Over which line of latitude does the ITCZ lie? (1 x 2) (2)

1.1.3 Which season is it in the Southern Hemisphere? Give a reason for your answer (2 x 2) (4)

1.1.4 Name the planetary winds that are blowing towards the ITCZ. (1 x 2) (2)

1.4.5 Explain why heavy rain is shown at the ITCZ. (3 x 2) (6)

[16]

HINTS:

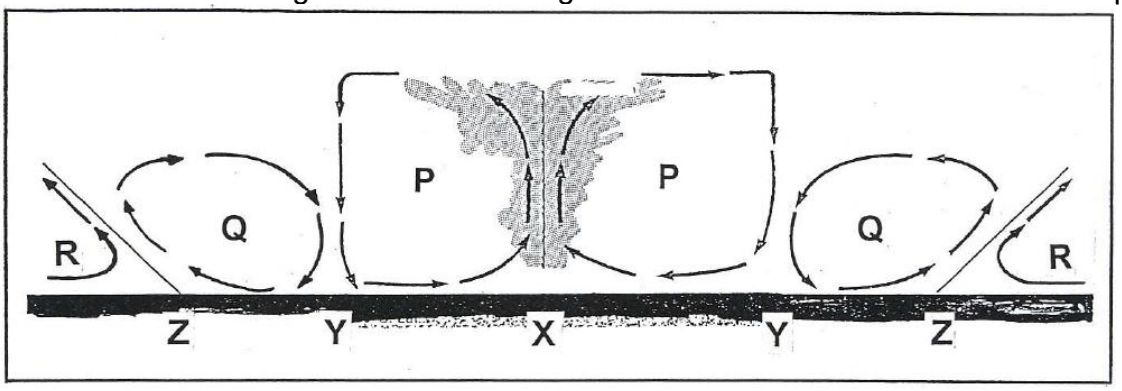
Hint 1: You need to be able to apply what you have learnt in session 1 on global circulation.

Hint 2: Also draw on what you have learnt in gr. 10 about the formation of clouds and rain to answer this question.

Hint 3: Look at the location of the pressure cells in comparison to the latitudes to determine the season.

QUESTION 2: 15 minutes 20 marks *(Source: 2008 Exemplar)*

2. Refer to the figure below showing the tri-cellular circulation of the atmosphere.



2.1.1. Why do meteorologists refer to a tri-cellular circulation of the atmosphere? (1 x 2) (2)

2.1.2. (a) Identify the THREE cells of circulation labelled P, Q and R respectively. (3 x 2) (6)

(b) What does the abbreviation ITCZ stand for? (1 x 2) (2)

(c) Where, at X, Y or Z, would the ITCZ be found? (1 x 2) (2)

(d) Name any TWO weather conditions that one will experience at the ITCZ. (2 x 2) (4)

(e) Explain why the weather conditions mentioned in 2.1.2.d occur at the ITCZ. (2 x 2) (4)

[20]

QUESTION 3: 5 minutes 10 marks *(Source: DoE March 2009 Supplementary Paper)*

3.1 Refer to the figure below. Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false ‘next to the question

3.1.1 The diagram illustrates conditions that exist during daytime.

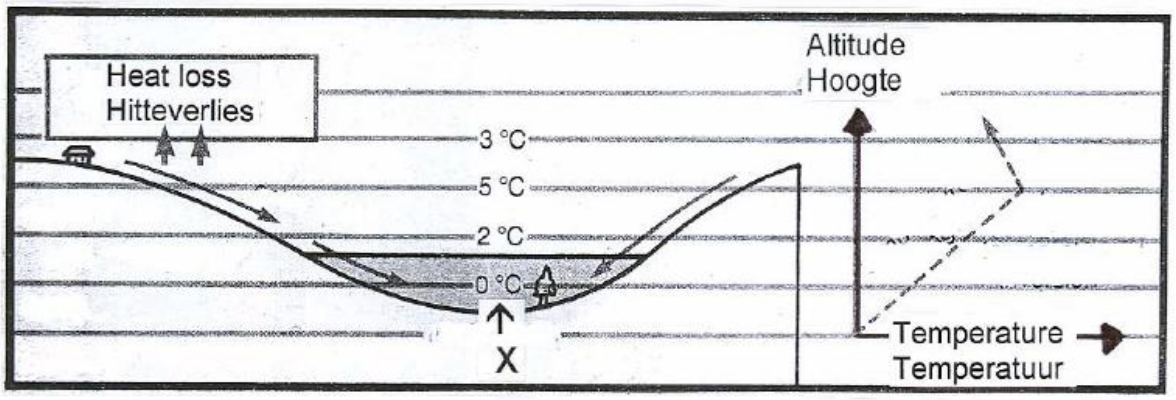
3.1.2 The graph illustrates a temperature inversion.

3.1.3 The downward flow of air illustrated in FIGURE 1.1 is known as anabatic air flow.

3.1.4 The zone marked X is the warm thermal belt.

3.1.5 The heat loss is as a result of terrestrial radiation. (5 x 2) [10]

FIGURE 1.1 FIGUUR 1.1



HINTS

Hint 1: Always determine if day or night conditions are shown in the valley

Hint 2: Describe the process of temperature inversions step by step when asked.

QUESTION 4: 6 minutes 12 marks *(Source: DoE November 2009)*

4.1 Climatologists discovered many years ago that a reversal in wind direction occurs along the coastline from daytime to night-time. These reversed wind conditions are referred to as land and sea breezes. Land and sea breezes are localised and have a moderating influence on coastal temperatures. Use your knowledge of land and sea breezes, and also refer to the figure on the following page to answer the questions below.

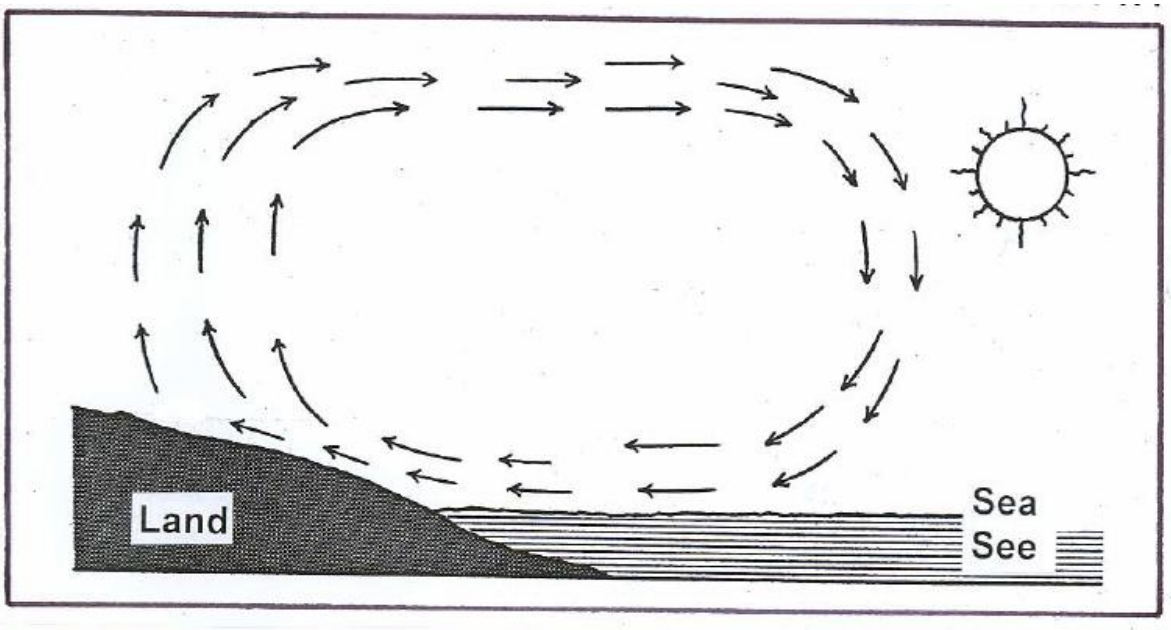
4.1.1 Does the figure illustrate a land breeze or a sea breeze? (1 x 2) (2)

4.1.2 What does it mean if one says the breeze is localised? (1 x 2) (2)

4.1.3 Briefly describe the development of the breeze illustrated in FIGURE 1.4. (3 x 2) (6)

4.1.4 The breeze illustrated in FIGURE 1.4 will result in high-income suburbs with high land values along the coastline bordered by warm ocean currents. Give ONE reason why this is so. (1 x 2) (2)

[12]



QUESTION 5: 10 minutes 16 marks *(Source: DoE November 2008)*

5.1 Geographers discovered many years ago that heat emissions in urban areas affect the climate. Use your knowledge of heat islands and refer to the figure below to answer the questions below.

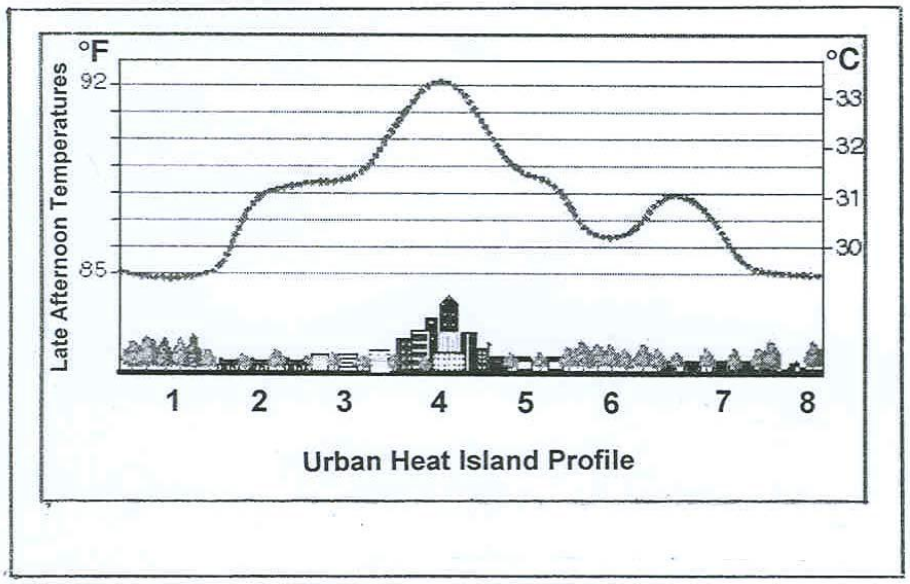
5.1.1 Explain what is meant by the term *heat island*. (1 x 2) (2)

5.1.2 Which part of the city is experiencing the highest temperature? (1 x 2) (2)

5.1.3 State TWO ways in which you think people's lives have been changed by the existence of heat islands. (2 x 2) (4)

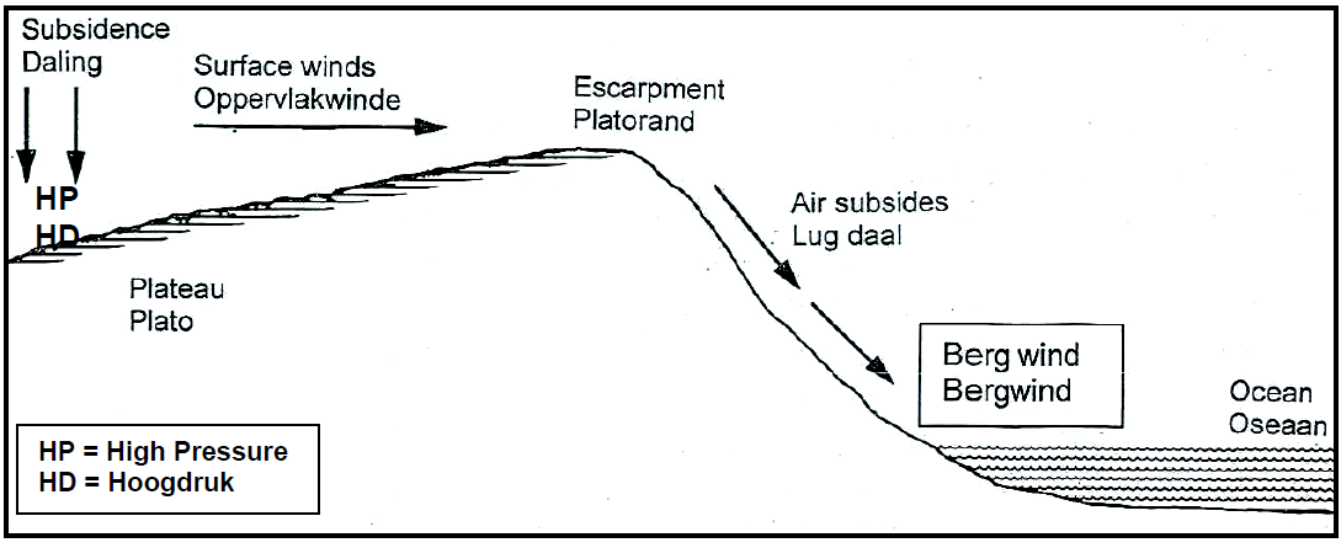
5.1.4. Give TWO reasons why modern buildings have an effect on heat islands. (2 x 2) (4)

5.1.5 Suggest TWO measures that can be taken to reduce high temperatures in the city centre. (2 x 2) (4)
[16]



QUESTIONS 6: 15 minutes 12 marks *(Source: DoE November 2010)*

6.1 Refer to the figure below showing the development of the South African bergwind. Strong subsidence over the plateau of South Africa results in a well-developed high-pressure cell over the interior, which will result in specific weather conditions there.



6.1.1 Name the high-pressure cell visible in the figure above that result from subsidence over the plateau. (1 x 2) (2)

6.1.2 How does the berg wind affect the weather along the southeast coast of South Africa? (2 x 2) (4)

6.1.3 Name the environmental hazard associated with the development of berg winds. (1 x 2) (2)

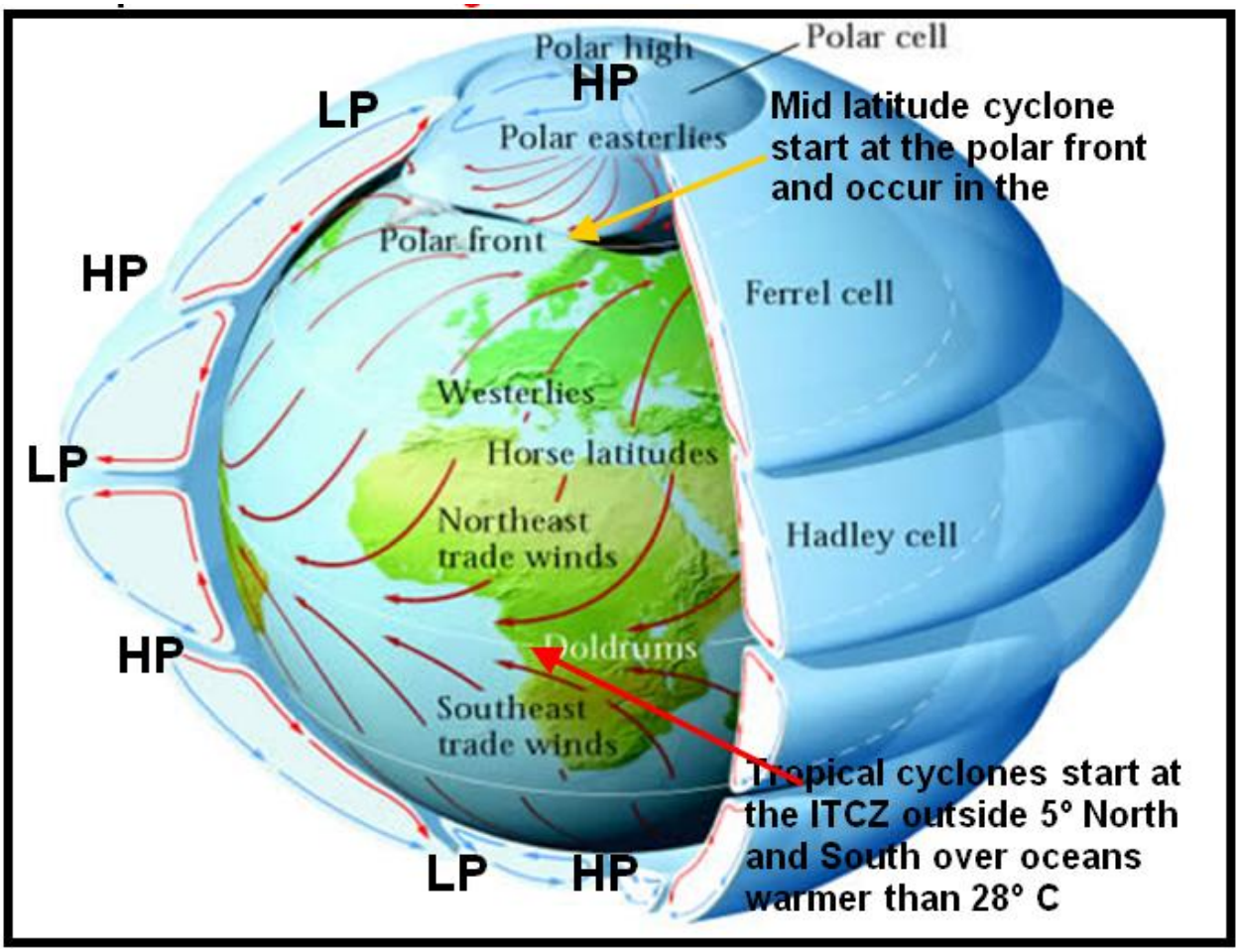
6.1.4 State ONE possible measure that can be introduced to reduce the impact of the environmental hazard named in QUESTION 6.1.3 (1 x 2) (2)

6.1.5 During which season do berg winds mainly affect the weather along the southeast coast of South Africa? (1 x 2) (2)

[12]

SECTION B: ADDITIONAL CONTENT NOTES

Planetary wind system

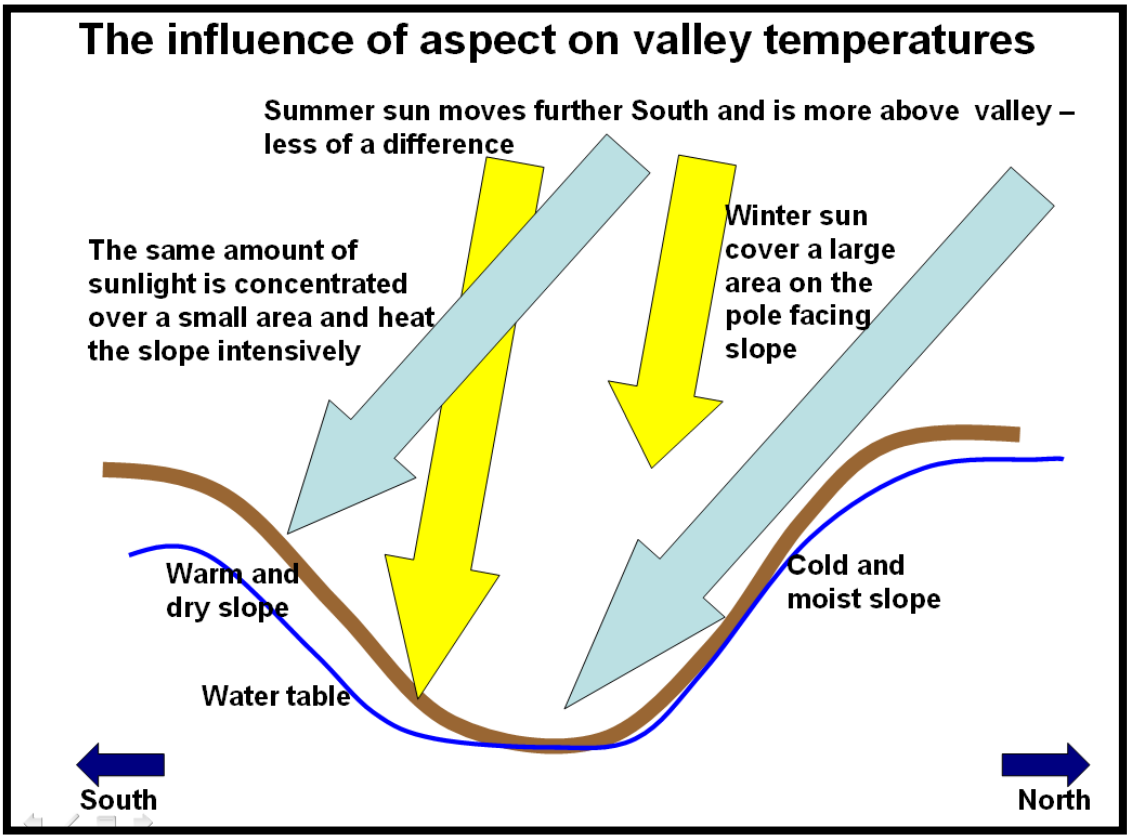


Tertiary Circulations – Microclimate

VALLEY CLIMATES

Aspect

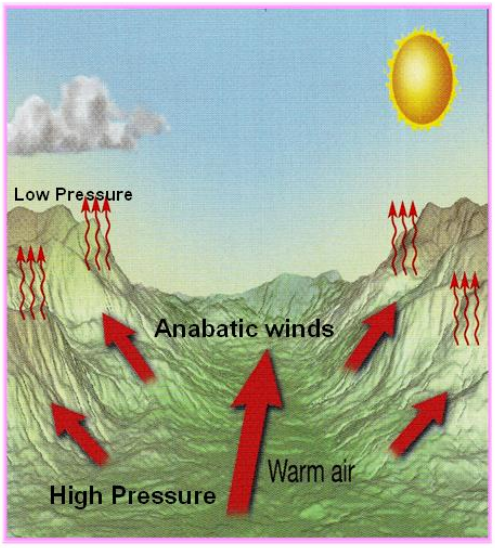
- The direction that a slope faces determines how much sunlight it will receive.
- Slopes that are parallel to the equator experience large differences between temperatures.
- Slopes facing the equator in both hemispheres are warmer; this leads to more evaporation of ground water and drier soil
- Slopes facing the poles are much colder; this causes less evaporation and moist soil conditions



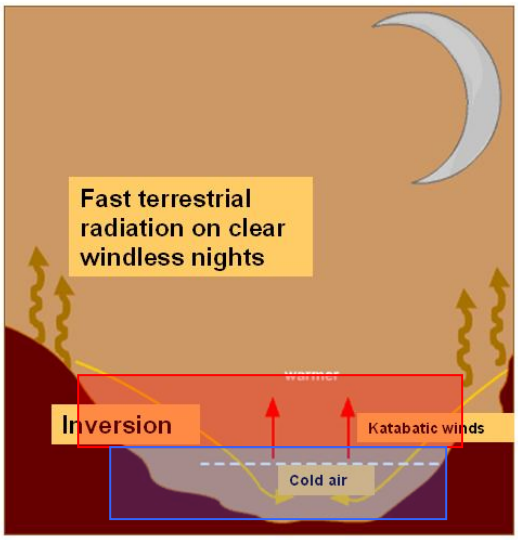
Day conditions in a valley	Night conditions
– Hills heat up first as sun shines on them first – Air above hills heats up and rises causing LP to develop on hills – Cold air in valley forms HP – Winds blow from the HP on the valley floor to the LP on the hills – These winds are called Anabatic winds – The whole wind system that develops in the valley is called Valley winds	– On cloudless nights, the terrestrial radiation takes place fast and the valley cools down quickly – On windless nights the air in a valley does not mix and form layers with different temperatures – The air in contact with the cold land surface cools down more than the rest of the air – This cold air becomes dense and heavy and drains to the bottom of the valley – These are Katabatic winds – The cold air displaces the warmer air upwards – The layer of warm air above the cold air forms a temperature inversion (negative temperature lapse rate) – Frost forms on the cold valley floor on winter nights

Day and night conditions in a valley

Day – Anabatic winds



Night – Katabatic winds and temperature inversion



3. URBAN CLIMATES

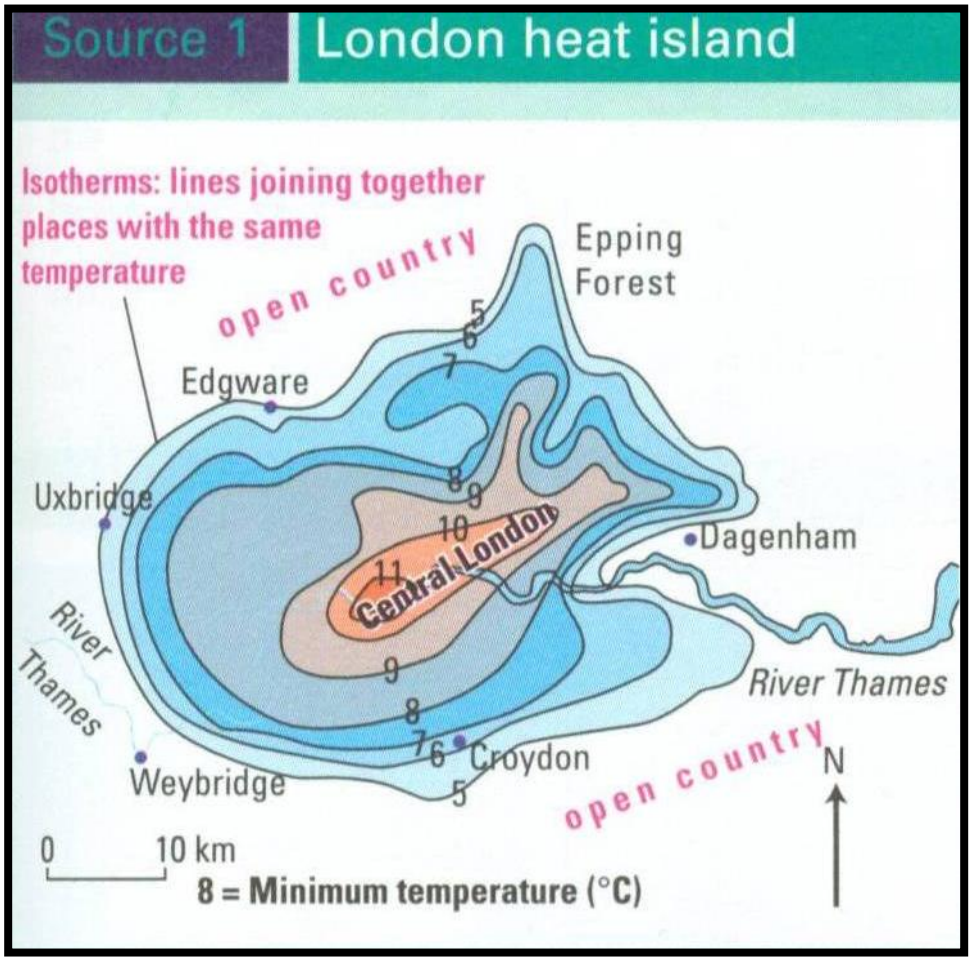
Cities alter the local climate because:

- Artificial surfaces like tar and glass in cities absorb more heat
- Vehicles, electric equipment, factories etc., generate excess heat in cities
- More air pollution over cities traps more heat in the lower layers
- The pollutants in the air over cities act as condensation nuclei, and condensation takes place easier in the dirty air

Owing to the factors mentioned above, a heat island forms over a city. This is a warm bubble of polluted air over the city. During the night the heat island is smaller and more concentrated due to cooler conditions. During the day the heat island is larger and the pollution is less concentrated as the warmer day conditions lead to convection.

This is how weather in cities differs from rural areas:

- Winds are slower due to the tall buildings that cause friction, but in some streets the winds can be very strong as the wind is funnelled down a channel
- The air over cities is drier as there is less evaporation from the artificial surface, and rainwater is drained into the storm water system
- More condensation occurs due to the pollutants in the air and the warmer conditions which cause air to rise. Therefore, cities are cloudier than rural areas.
- Cities experience more precipitation due to more clouds forming in spite of the fact that the air is drier.
- There is more runoff and less infiltration in cities due to the artificial surfaces.
- Water vapour is released into the air from power stations and factories like paper manufacturing plants.



SECTION C: HOMEWORK

QUESTION 1: **5 minutes** **10 marks** *(Source: DoE November 2010)*

1.1 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number.

1.1.1 Primary circulation refers to the circulation within one hemisphere on a global scale.

1.1.2 Pressure gradient refers to the difference in pressure between two points.

1.1.3 Isotherms are lines on a map that join places of equal pressure.

1.1.4 In the southern hemisphere air movement around a high pressure (anticyclone) is clockwise.

1.1.5 The polar front is formed where warm subtropical air and cool subpolar air meet.

(10 x 2) [10]

QUESTION 2: 5 minutes 10 marks *(Sources: DoE November 2009)*

2.1 Refer to the figure below illustrating a very specific climatic condition that will develop in a valley in the southern hemisphere lying outside the Tropic of Capricorn. Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question.

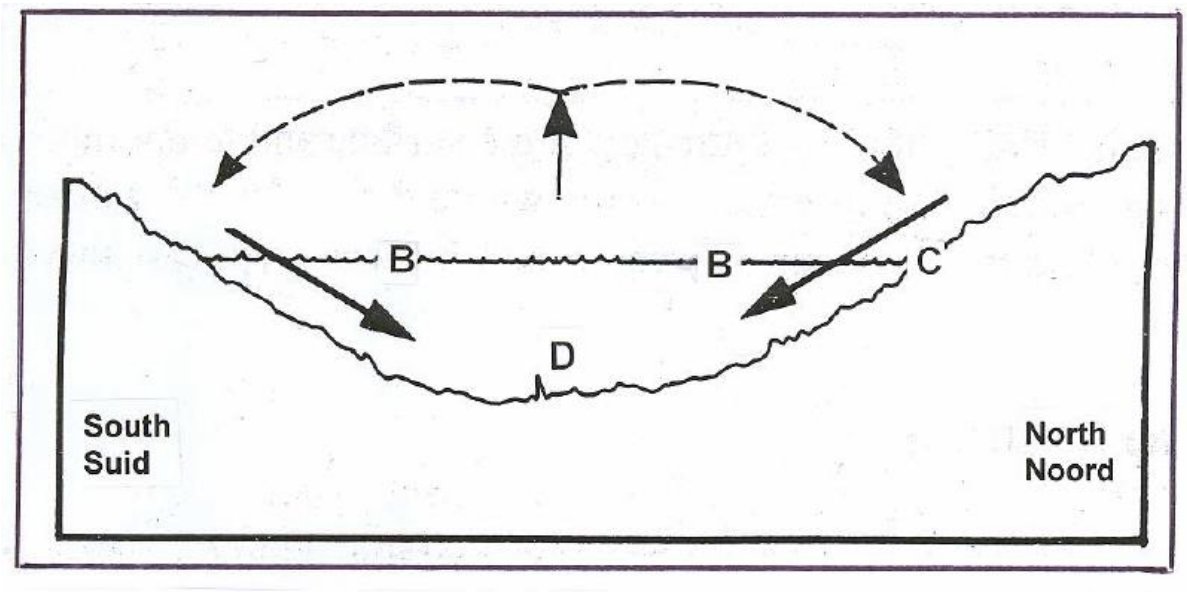
2.1.1 The figure illustrates the development of an anabatic wind.

2.1.2 The climatic condition illustrated in the figure below, develops at night.

2.1.3 The zone marked B is the warm thermal belt.

2.1.4 Place C will record the highest temperatures in this valley.

2.1.5 At night warm air sinking down the slope, will collect at D. (5 x 2) [10]



QUESTION 3: 20 minutes 20 marks *(Source: DoE Prep 2008)*

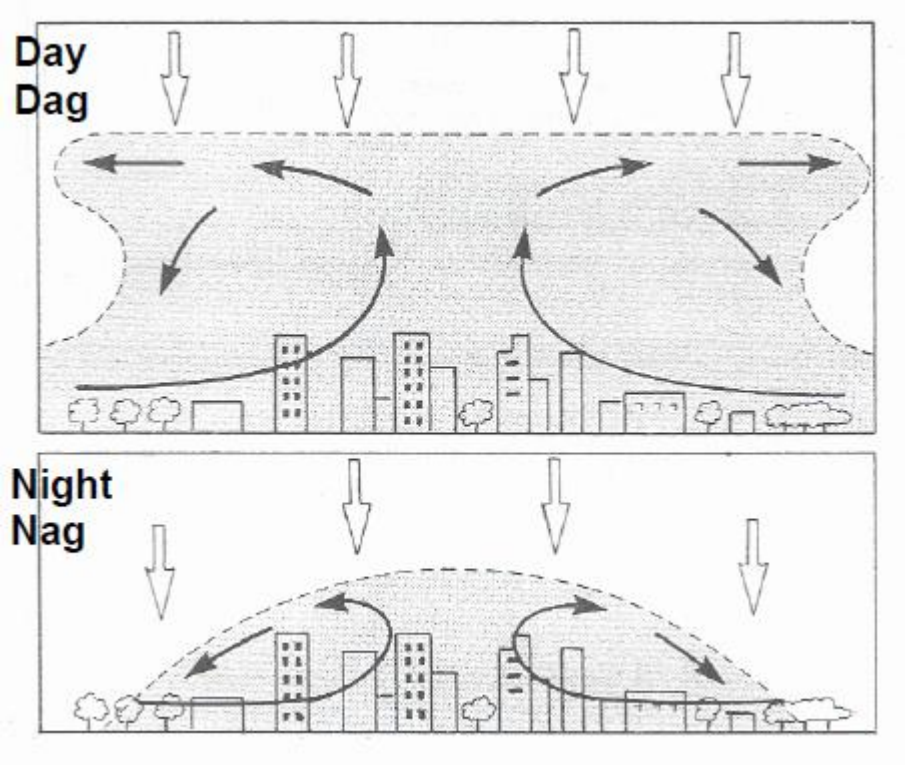
3.1 Refer to the figure below showing a pollution dome over a large urban settlement.

3.1.1 During night-time the pollution dome is much lower than during daytime. Give reasons why this is so. (2x2)(4)

3.1.2 State the environmental problem resulting from a pollution dome that is situated closer to the earth's surface. (1x2)(2)

3.1.3 Name ONE way in which we can minimise the environmental problem mentioned in question 3.1.2. (1x2)(2)

3.1.4. Write a paragraph of no longer than 12 lines to explain why cities are warmer than the surrounding rural areas. (6 x 2)(12)
[20]



SECTION D: SOLUTIONS AND HINTS TO SECTION A: TOPIC 1

QUESTION 1

1.1.1 Inter-tropical convergence zone ✓✓ (1 x 2) (2)

1.1.2 Tropic of Capricorn/ 23½°S ✓✓ (1 x 2) (2)

1.1.3 Summer – sun overhead Tropic of Capricorn/ITCZ in Southern Hemisphere. ✓✓✓✓ (2 x 2) (4)

1.1.4 Tropical easterlies ✓✓ (1 x 2) (2)

1.3.5 Air is hot air therefore light and rises, ✓✓
Convergence of winds leads to air rising, ✓✓
Rising air cools and condenses. ✓✓ (3 x 2) (6)

[16]

QUESTION 2

2.1.1 (a) Because circulation occurs in three cells in each hemisphere ✓✓ (1 x 2) (2)

(b) P – Ferrell (2) ✓✓
Q – Hadley (2) ✓✓
R – Polar (2) ✓✓ (3 x 2) (6)

2.1.2 (a) Inter-Tropical Convergence Zone ✓✓ (1 x 2) (2)

(b) X ✓✓ (1 x 2) (2)

(c) High temperatures/Hot ✓✓
Cumulonimbus cloud/Heavy cloud cover ✓✓
Thundershowers/Heavy downpours ✓✓ [Any TWO] (2 x 2) (4)

d) (Along the equator where it is warm (✓✓
Rapidly rising air condenses and form clouds (✓✓
Large scale condensation results in heavy rain ✓✓
[Any TWO. Must refer to weather conditions mentioned above] (2 x 2) (4)

[20]

QUESTION 3

3.1.1 False (2) ✓✓
3.1.2 True (2) ✓✓
3.1.3 False (2) ✓✓
3.1.4 False (2) ✓✓
3.1.5 True (2) ✓✓ **(5 x 2) [10]**

QUESTION 4

4.1.1 Sea breeze ✓✓ (1 x 2) (2)

4.1.2 Happens on small / local scale / in immediate surroundings ✓✓
Microclimatic condition ✓✓
Tertiary circulation ✓✓ [Concept] [Any ONE] (1 x 2) (2)

4.1.3 Land heats up more during daytime ✓✓
Causes low pressure to develop over land ✓✓
Air rises over land ✓✓
Sea takes longer to heat up during the day ✓✓
High pressure at sea ✓✓
Air moves from high to low pressure ✓✓
Breeze from sea to land ✓✓ [Any THREE] (3 x 2) (6)

4.1.4 High-income suburbs along the coastline will benefit from the cooling /
Moderating effect of the sea breeze ✓✓
Experiences clean, fresh air ✓✓
Breeze blows from sea to land ✓✓ [Any ONE] (1 x 2) (2)

[12]

QUESTION 5

5.1.1 An urban area that records higher temperatures than the surrounding
rural areas ✓✓ [Concept] (1 x 2) (2)

5.1.2 Downtown/CBD/area 4 ✓✓ (1 x 2) (2)

5.1.3 Trapped pollutants could result in respiratory problems ✓✓
Use of air-conditioners because of higher temperatures ✓✓
Deterioration of buildings ✓✓
More renovation of buildings such as frequent painting ✓✓
Unpredictable rainfall ✓✓
Increase in health problems/examples related to heat island ✓✓
Increase in stress/discomfort ✓✓
Movement to suburbs/counter-urbanisation ✓✓
[Any TWO. Accept reasonable alternatives] (2 x 2) (4)

5.1.4 Modern buildings are made of a lot of glass/steel which results in the Multiple reflection of heat ✓✓
Buildings create a greater surface area which absorbs/reflects heat ✓✓
Buildings are made of concrete which absorbs/reflects more heat ✓✓
Tall buildings trap heat as wind cannot disperse the heat ✓✓
More air conditioners/heaters ✓✓
More buildings therefore less vegetation to play cooling role ✓✓
Any TWO] (2 x 2) (4)

5.1.5 Industrial decentralisation ✓✓
Laws to control/restrict air pollution ✓✓
Reduce building density ✓✓
Introduce open spaces / green belts / parks to absorb carbon dioxide ✓✓
Measures to reduce pollutants / greenhouse gases as they trap heat ✓✓
Public transport to reduce emissions ✓✓
Cleaner fuels ✓✓
Flexi-time ✓✓
Erect green buildings✓✓
Law enforcement to ensure sustainable units / local agenda 21 ✓✓
[Any TWO. Accept reasonable alternatives] (2 x 2) (4)
[16]

QUESTION 6

6.1.1 Kalahari/Continental high ✓✓ (1 x 2) (2)

6.1.2 Temperatures will warm up ✓✓
Humidity level will be low/dry ✓✓
No/little cloud cover ✓✓
No rain ✓✓ [Any TWO] (2 x 2) (4)

6.1.3 Veldfires/Bushfires ✓✓ (1 x 2) (2)

6.1.4 Educating people on the dangers associated with veldfires – accept example ✓✓
Look-out towers in bergwind season ✓✓
Firebreaks ✓✓
Warning over weather forecast ✓✓ [Any ONE] (1 x 2) (2)

6.1.5 Winter✓✓ (1 x 2) (2)
[12]

TOPIC 1: MID-LATITUDE CYCLONES

Learner Note: Mid latitude cyclones influence SA Weather a lot in winter. You need to know the stages of development, the components of the cyclone and how it influences weather at places. You also need to understand how the mid latitude cyclone impacts on the environment and the economy.

SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: 15 minutes 18 marks *(Source: DoE: March 2009)*

1.1 Refer to the figure below showing a satellite image and synoptic weather chart for 26 June 2007. Find the two mid-latitude cyclones labelled P and Q. Carefully read through the weather update and answer the following questions.

1.1.1 (a) Provide evidence from the synoptic chart indicating that P and Q are mid-latitude cyclones. (1 x 2) (2)

(b) Which one of the two mid-latitude cyclones, P or Q, is most likely to be older? (1 x 2) (2)

(c) Give ONE reason for your answer to QUESTION 1.1.1(b). (1 x 2) (2)

1.1.2 (a) With reference to the satellite image and synoptic weather chart, explain why the Eastern Cape is experiencing rain and very cold conditions. (4 x 2) (8)

(b) Which weather condition, not mentioned in the weather report, is clearly visible on the satellite image? (1 x 2) (2)

(c) Give ONE reason why it is important for people living in the Eastern Cape to be made aware of the weather conditions mentioned in QUESTION 1.1.2(a). (1 x 2) (2)
[18]

FIGURE 1.4

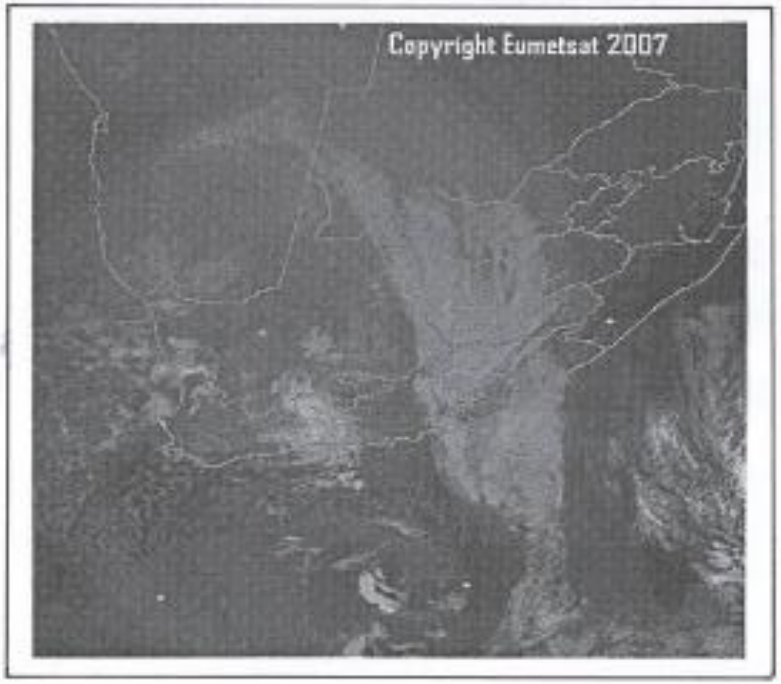
FIGUUR 1.4

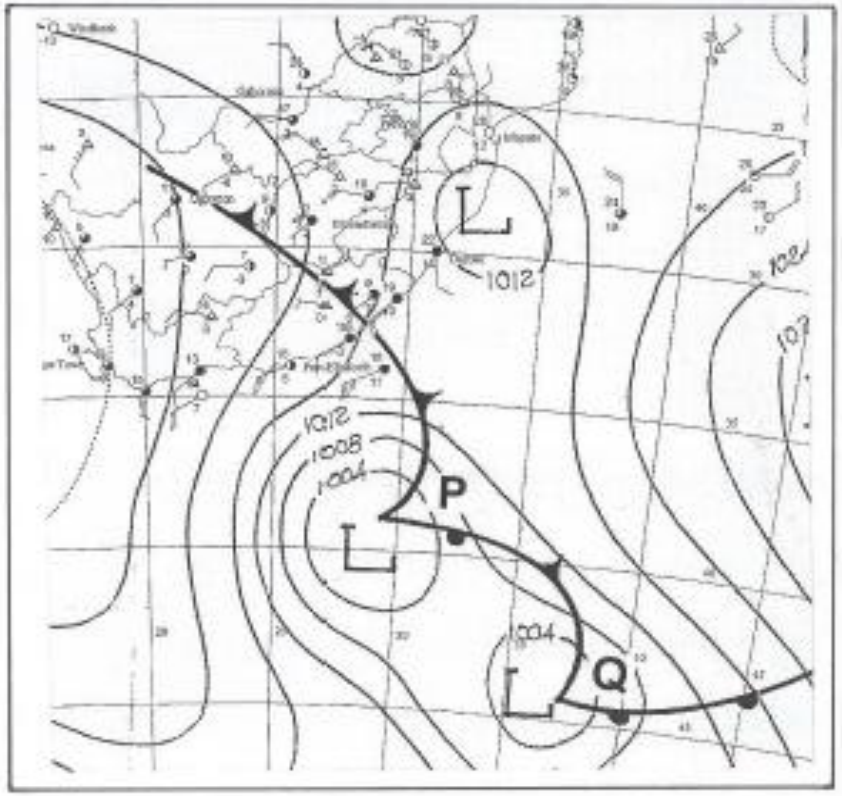
Update on the cold front heading for Gauteng – 26 June 2007

As the cold front moves over the central and south-eastern parts of South Africa today, it has left a trail of heavy falls, very cold conditions, very rough seas and gale force winds over the interior and along the coast. At present the cold front is positioned over the Eastern Cape, bringing heavy rain and very cold temperatures to the province. Snowfalls are expected on the mountains of the Eastern Cape today, as well as in Lesotho, the Drakensberg and the eastern Free State overnight and tomorrow. Sea conditions remain very hazardous, with gale force winds and very rough seas persisting along the southern Cape coast today, spreading towards the Wild Coast and KwaZulu-Natal coast later on Tuesday.

Inligting oor die koue front wat na Gauteng toe op pad is – 26 Junie 2007

Soos die koue front vandag oor die sentrale en suidoostelike gedeeltes van die land beweeg, het dit 'n spoor van swaar reën, baie koue toestande, 'n stormagtige see en stormsterk winde oor die binneland en langs die kus nagelaat. Tans is die koue front oor die Ooskaap gelee en dit lei tot swaar reën en baie koue temperature in die provinsie. Sneeuneerslae word vandag oor die berge van die Ooskaap verwag, en oormag en môre in Lesotho, oor die Drakensberge en die oostelike Vrystaat. Seetoestande bly gevaarlik met stormsterk winde en 'n stormagtige see wat vandag langs die Kaapse suidkus heers om Dinsdag na die Wildekus en KwaZulu-Natalkus uit te brei.





HINTS

Hint 1: Read the article carefully; many of the answers are in there.

Hint 2: Read the synoptic map carefully as it also gives you some of the answers.

QUESTION 2: 5 minutes 10 marks *(Source: DoE November 2008)*

2.1 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (2.1.1 – 2.1.5). Refer to the figure below.

2.1.1 The weather system illustrated in FIGURE 2.1 is a mid-latitude cyclone.

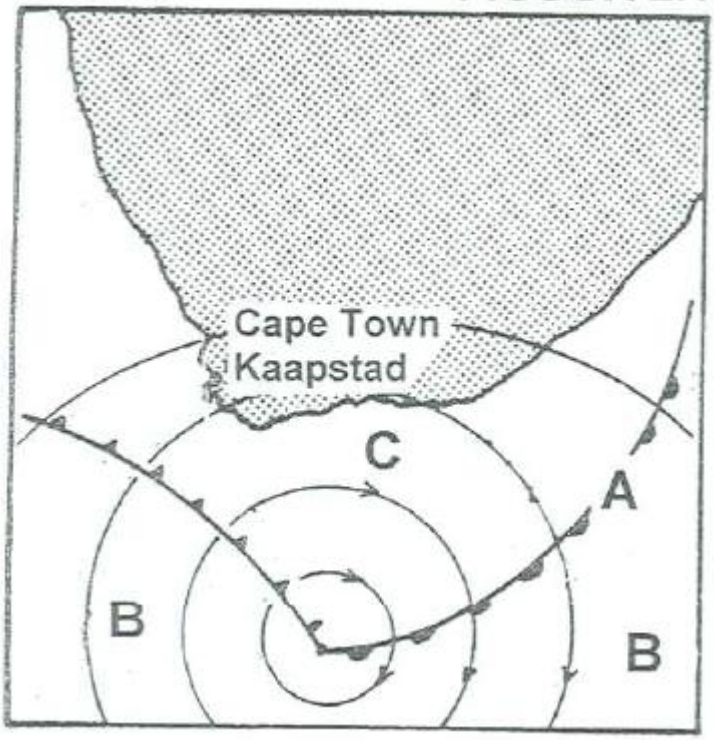
2.1.2 The front at **A** is the warm front.

2.1.3 The zone marked **B** is the warm sector.

2.1.4 The weather system illustrated in FIGURE 2.1 has reached the occlusion stage.

2.1.5 Easterly winds are experienced at **C** (5 x 2) [10]

FIGURE 2.1 FIGUUR 2.1



HINTS

Hint 1: Do not guess.

QUESTION 3: 10 minutes 12 marks *(Source: DoE November 2008)*

3.1. The South African Weather Service issued the following weather warnings for 26 June 2007. A mid-latitude cyclone was present.

- Gale-force south-westerly winds are expected between Plettenberg Bay and East London, with very rough seas from Lamberts Bay to East London.
- Very cold and windy conditions are expected in the northern parts of the Eastern Cape.
- Snowfalls are expected on the northern high grounds of the Eastern Cape and Lesotho.
- Conditions are favourable for the development and spread of fires over Limpopo, Mpumalanga, Gauteng and the northern parts of KwaZulu-Natal.

3.1.1 Why is it important for the South African Weather Service to issue these weather warnings? (2 x 2) (4)

3.1.2 Describe the environmental impact this mid-latitude cyclone might have in all the affected regions. (2 x 2) (4)

3.1.3 Imagine you are part of a team sent in to assist people affected by this mid-latitude cyclone, what would your plan of action be? (2 x 2) (4)

[12]

QUESTION 4: 10 minutes 16 marks *(Source: DoE November 2010)*

4.1. Refer to the synoptic weather map below and answer the questions:

4.1.1 Identify the low pressure cell labelled **A**. (1 x 2) (2)

4.1.2 Indicate why the surface winds that diverge out of cell **B** are dry and cold. (1 x 2) (2)

4.1.3 Which of the mid-latitude cyclones, labelled **C** and **D**, originated first? (1 x 2) (2)

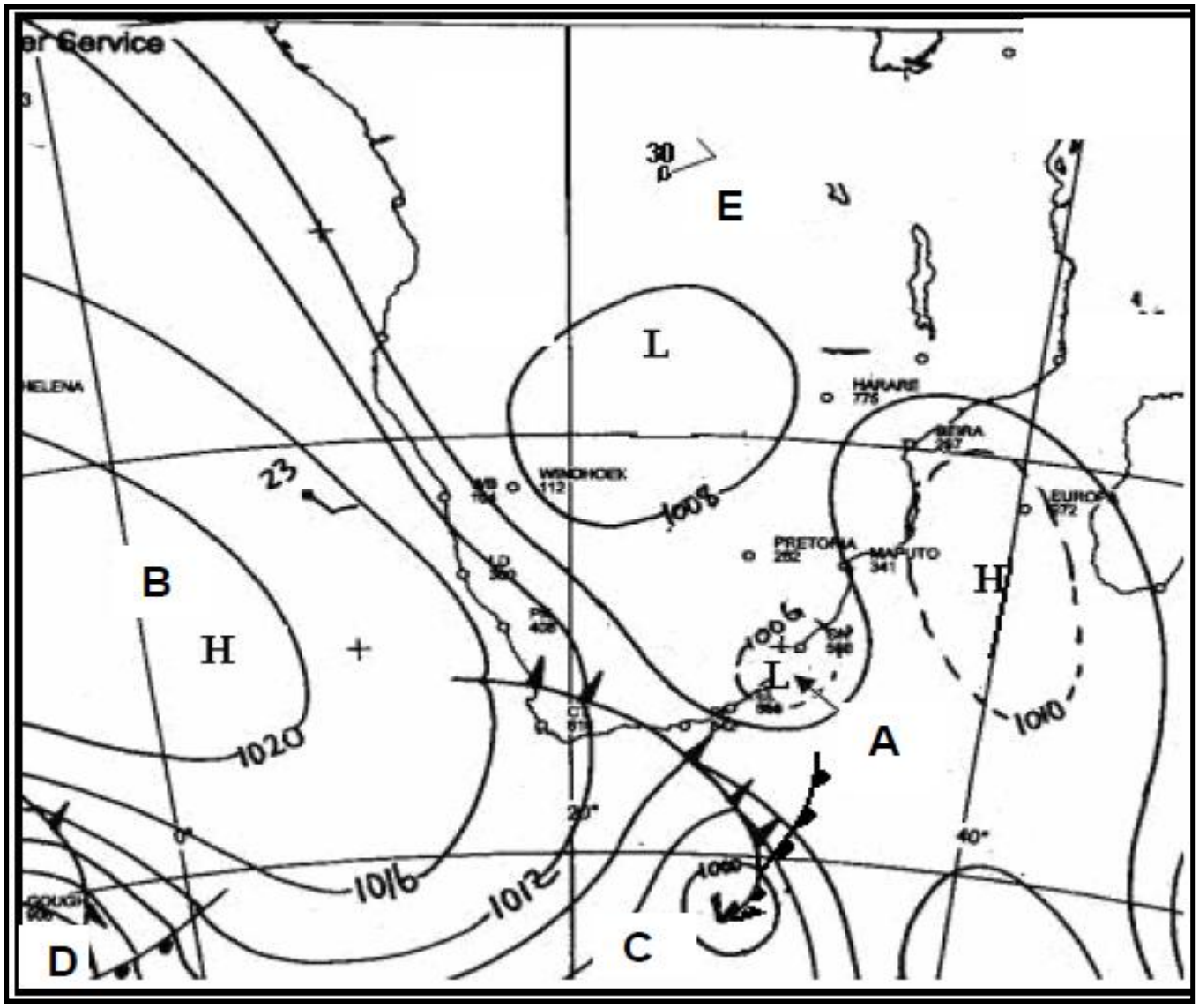
4.1.4 Give ONE reason for your answer to QUESTION 4.1.3. (1 x 2) (2)

4.1.5 Give the term used to describe a series of mid-latitude cyclones passing over an area in quick succession. (1 x 2) (2)

4.1.6 Name TWO effects of mid-latitude cyclones on farming in the South-western Cape. (2 x 2) (4)

4.1.7 What will happen to low-pressure cell **A** if mid-latitude cyclone **C** moves further eastwards? (1 x 2) (2)

[16]



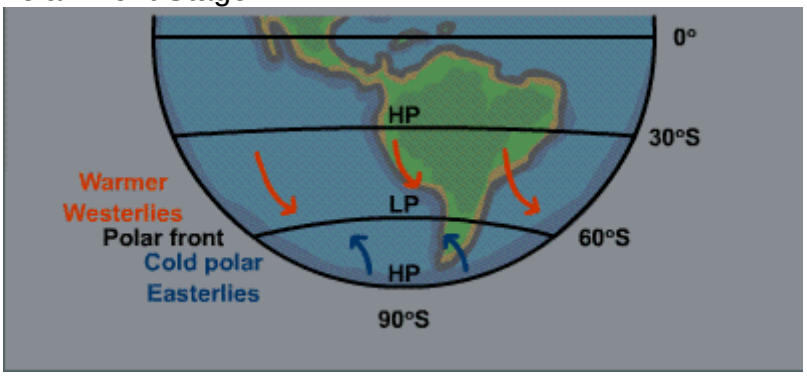
SECTION B: ADDITIONAL CONTENT NOTES

MID-LATITUDE CYCLONES

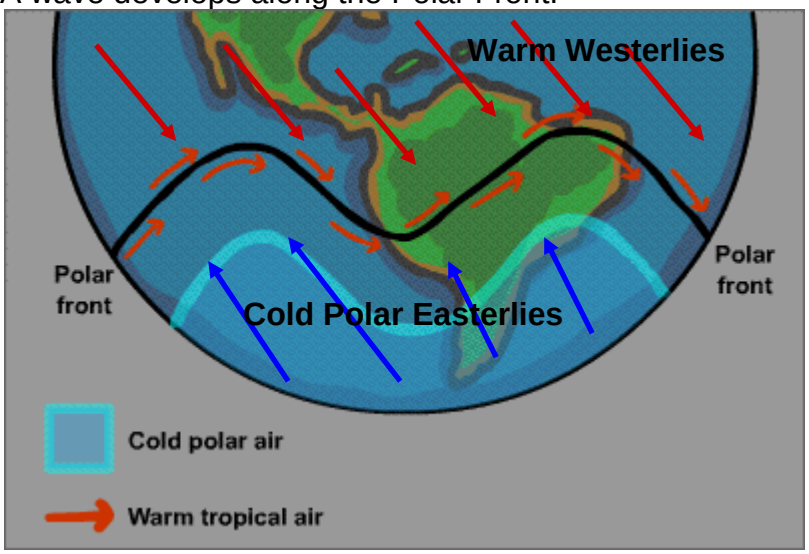
1. STAGE 1: POLAR FRONT STAGE

The warm westerly and cold polar easterlies blow in opposite directions along the polar front.
The different air masses do not have the same density, temperature and humidity and thus they do not mix, and friction develops between the air masses.
The polar front forms a wave due to the friction, and the low pressure intensifies.

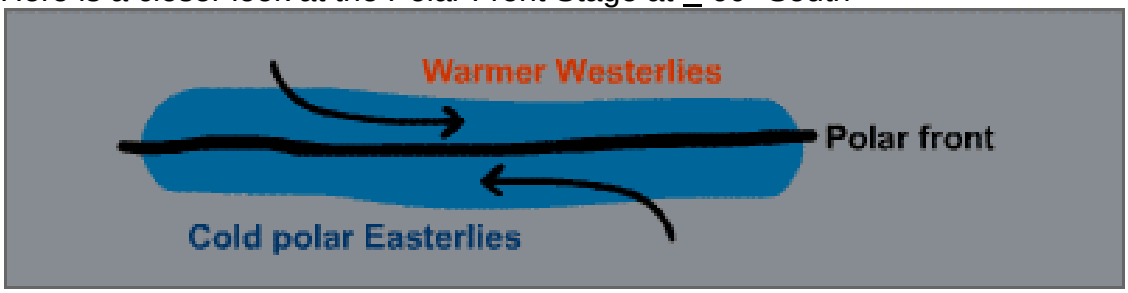
Polar Front Stage .



A wave develops along the Polar Front.



Here is a closer look at the Polar Front Stage at ± 60º South



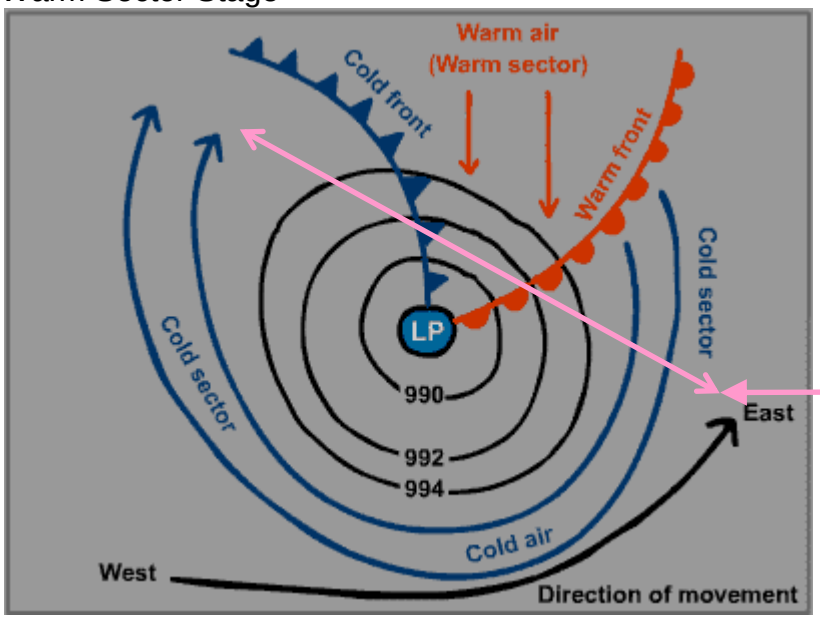
A wave develops due to the friction between the different air masses

1.2. STAGE 2: MATURE STAGE – WARM SECTOR STAGE

The low pressure intensifies and the mid- latitude cyclone develops and moves into the westerly wind belt away from the polar front. A well-developed cold and warm sector develops. The cold dense air moves faster and picks up the light humid less dense air in the warm sector. The cold sector becomes larger than the warm sector as the cold air moves and lifts the warm air.

Cumulonimbus clouds form and heavy rain occurs along the cold front. The temperature and humidity decreases at the cold front, while the air pressure increases. The air at the cold front is lifted quickly, and thus thunderstorms develop at the cold front.

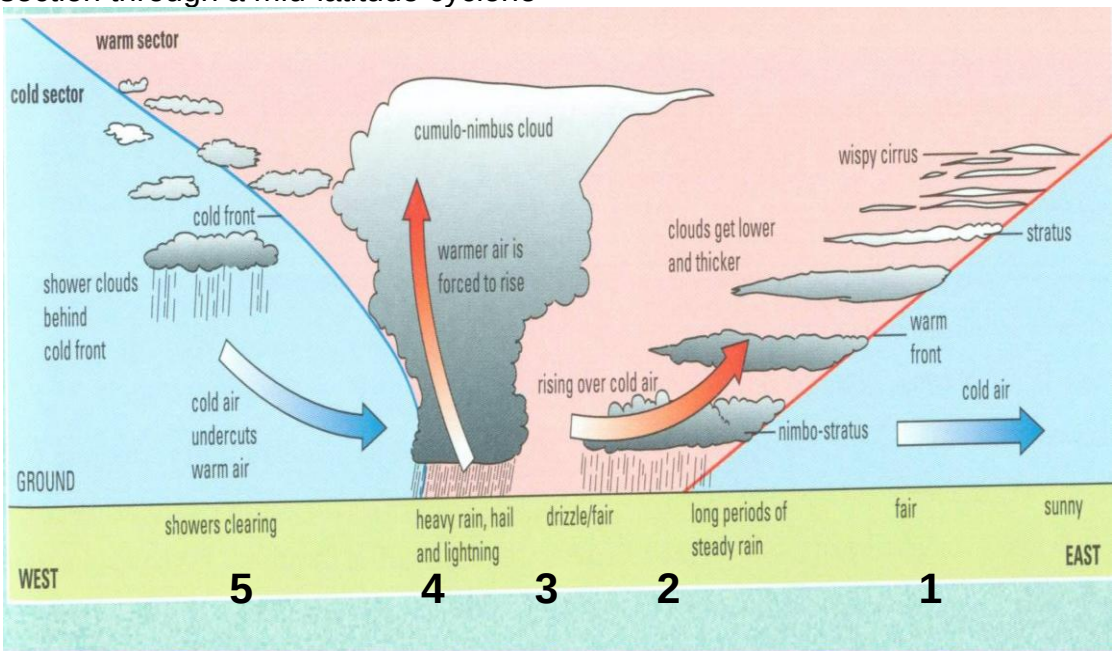
Warm Sector Stage



Line along which cross section below has been drawn

At the warm front the warm air cannot push the cold dense air away, and it glides over the cold air. This leads to stratus clouds forming and soft prolonged rain occurring. At the warm front, the air pressure decreases but the humidity and temperature increases.
A cross section along the pink line would render the conditions as illustrated in the sketch below. The mid latitude cyclone travels from west to east over SA.

Cross section through a mid-latitude cyclone



When a mid latitude cyclone passes over a place, the warm front conditions will be experienced first, then the warm sector conditions, and lastly, the cold sector conditions. It takes the cyclone between 2 – 5 days to pass over a place. The cyclone develops and dissipates over 5 – 10 days.

Weather conditions experienced as a mid-latitude cyclone moves over a place. (Refer to number on cross section.)

	Part of cyclone	Weather experienced
1	Cold sector before warm front	• Cold dry conditions • Northerly winds • Air pressure dropping • Cirrus clouds visible • Winds strengthening • No precipitation
2	Warm front	• At the warm front the warm air cannot push the cold dense air away and it glides over the cold air. • This leads to nimbostratus clouds forming and soft prolonged rain occurring. • At the warm front the air pressure decreases, • but the humidity and temperature increases. • North Westerly winds • Warm front has a gradual gradient of 1:150 and 1:300
3	Warm sector	• Temperature at highest • Lowest air pressure • Some clouds with scattered rain, but the weather clears up partially • Humidity increases • North westerly, westerly winds
4	Cold front	• The cold dense air moves faster and picks up the light humid less dense air in the warm sector. • This leads to Cumulonimbus clouds forming and heavy rain along the cold front. • The temperature and humidity decreases at the cold front while the air pressure increases. • The air at the cold front is lifted quickly, and thus thunderstorms develop at the cold front.
5	Cold sector After cold front	• Cold conditions • Dry air – low humidity • Weather clears up • Few cumulus clouds • Air pressure rises • South westerly winds • Winds slow down

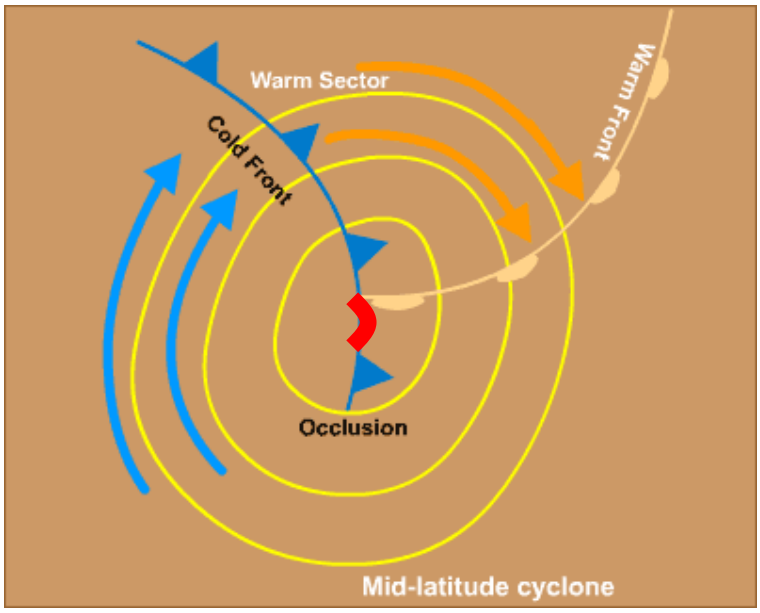
1.3. STAGE 3: OCCLUDED STAGE

The cold front overtakes the warm front and the cyclone dissipates as the air pressure increases and the rain clears up. An occluded front develops where the cold air lifts up the warm air and reaches the cold sector in front of the warm sector.

A temperature inversion occurs in this stage as all the warm air is lifted off the surface. There is cold air on the surface with a pool of warm air above it.

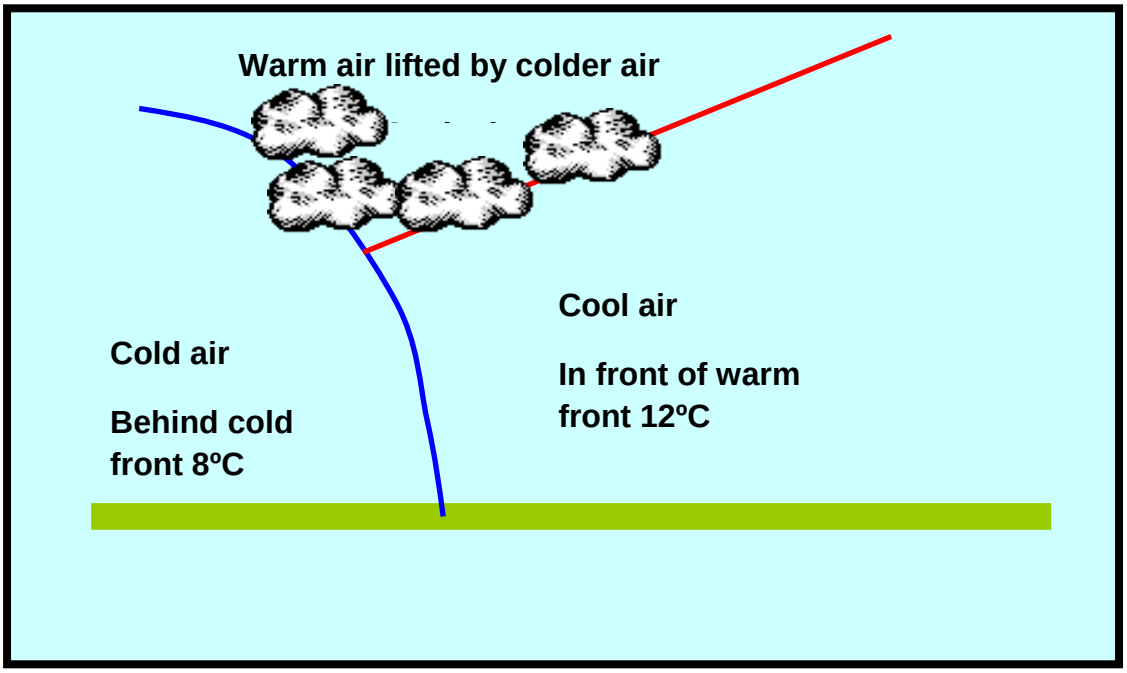
The air pressure rises and the weather clears up as the cyclone dissipates.

Occluded Front



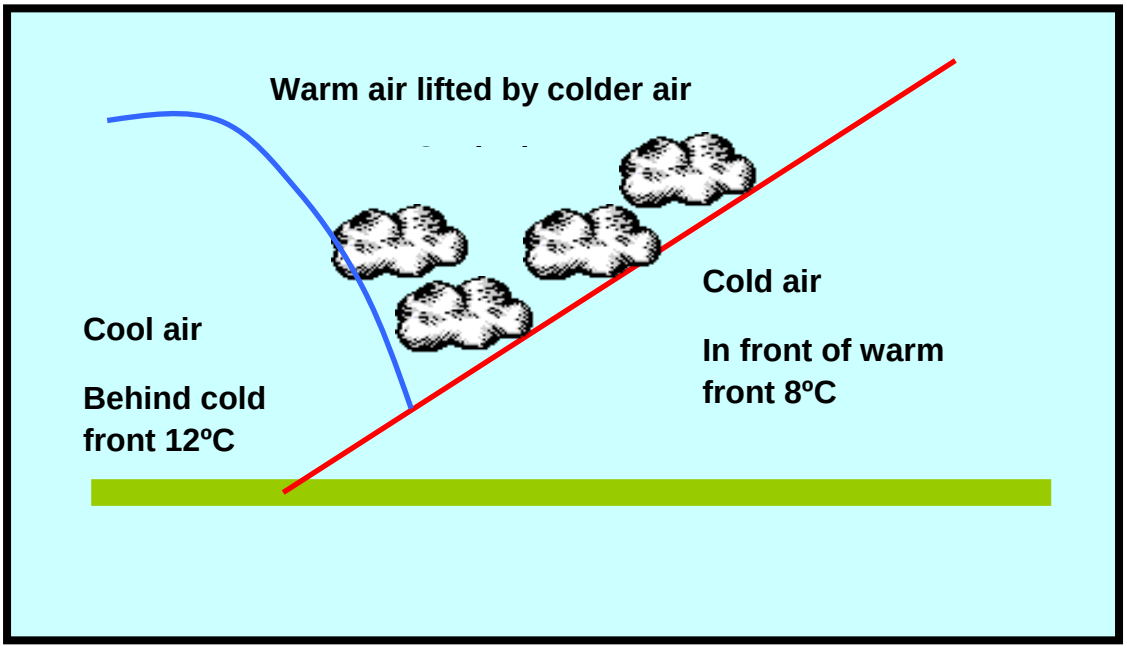
Two types of occlusion can take place, depending on the temperature of the cold sector in front of the warm front and after the cold front.

Cold front occlusions



The cold air behind the cold front is colder than the air in front of the warm front. The cold front wedges in below the warm air, and the cool air in front of the warm fronts. he cold front touches the surface

A Warm Front Occlusion

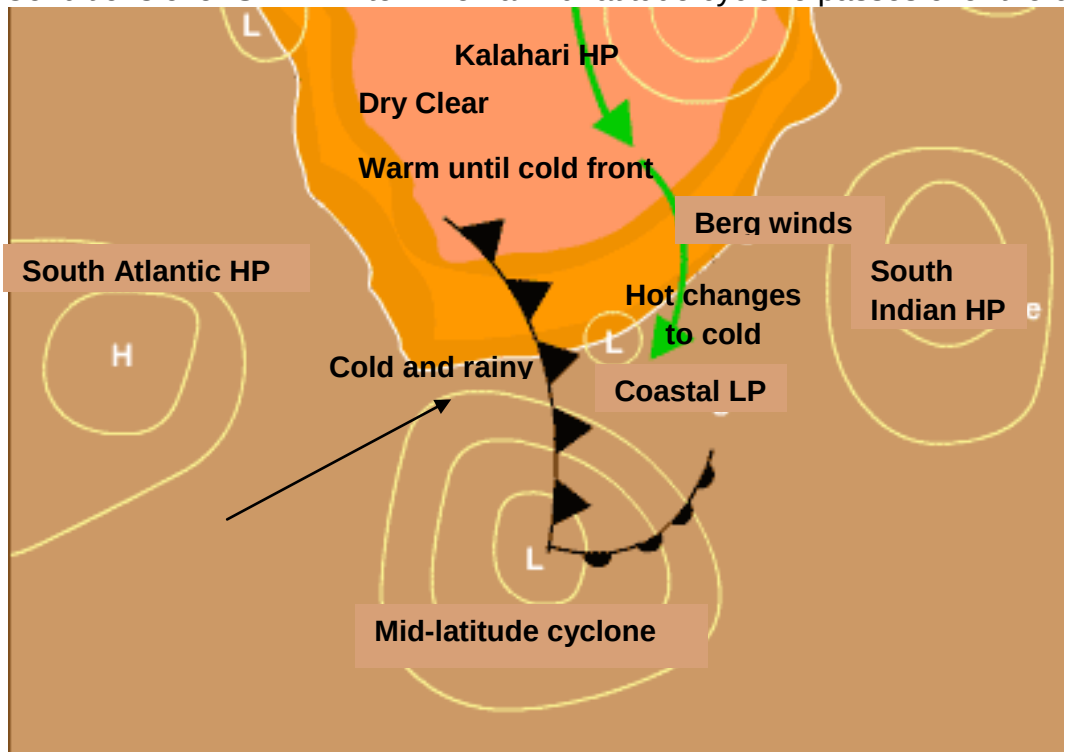


The air ahead of the warm front is the coldest. The cool air behind the cold front cannot displace the cold air and slides over it with the warm air from the warm sector. The warm front touches the surfaces.

The mid latitude cyclone is a large weather phenomenon that can stretch over 1000km. It often occurs in groups, called families of cyclones. In this case the cyclone furthest to the East is the oldest cyclone. The mid latitude cyclones develop through the entire year, but due to shifting direct sunlight and the moving heat equator, they only pass over South Africa in winter. In summer they occur south of the country. Berg wind conditions develop along the South East coast when a cyclone approaches, and the wind in front of the cyclone moves clockwise over the country and down the escarpment. The subsiding air heats up at DALR and can cause dry hot conditions at the coast, which is then soon replaced with very cold conditions when the cold front passes over the area.

1. 4. THE WEATHER EXPERIENCED OVER SOUTH AFRICA WHEN MID LATITUDE CYCLONES PASS OVER THE COUNTRY

Conditions over SA in winter when a mid-latitude cyclone passes over the country



SECTION C: HOMEWORK FOR TOPIC 1: MID LATITUDE CYCLONES

QUESTION 1: 25 minutes 26 marks *(Source November 2009)*

1. Refer to the satellite image in the information box below, showing the position of an approaching low-pressure. Answer the questions that follow.

1.1.1. (a) Identify the low pressure system labelled K on the satellite image in the figure with the essay (1 x 2) (2)

(b) During which season does the above-mentioned low-pressure system usually affect the weather of South Africa? (1 x 2) (2)

(c) Give the general direction of movement of the low-pressure system mentioned in QUESTION 1.1.1(a). (1 x 2) (2)

(d) Give ONE reason for the direction of movement of the low-pressure system as mentioned in QUESTION 1.1.1(c). (1 x 2) (2)

(e) Draw a sketch map of the satellite image in FIGURE 2.3 on page 24 indicating the position of the low-pressure system in relation to South Africa. Clearly label the cold front, the warm front and the warm sector on the drawing. (3 x 2) (6)

1.1.2 Why is it important for the South African Weather Service to issue weather warnings? Use the source in the box below, and the figure, and write a short essay (no longer than 12 lines), clearly indicating the value of weather forecasts and warnings. In your answer also indicate how reports forwarded by the public can improve weather forecasts. (6 x 2) (12)

KEEP YOUR WINTER WOOLIES OUT (Tuesday, 1 July 2008)

Nice clear skies with cool temperatures can be expected for Tuesday and Wednesday, but people in the Western Cape need to brace themselves for another few cold, wet and windy days from Thursday the 3rd of July 2008.

Satellite image showing the approaching low-pressure system on Monday the 30th June 2008 (Image courtesy Eumetsat, 2008).

The South African Weather Service has been issuing advisories for this approaching system since the beginning of the week. On Thursday gale-force northerly to north-westerly winds are expected between Cape Columbine and Cape Agulhas, accompanied by very rough seas, with wave heights in excess of 5 m. Very cold conditions over the western interior of the Western and Northern Cape, spreading to the northern interior of the Eastern Cape and southern Free State, can be expected.
The colder conditions are expected to reach the north-eastern parts of the country on Saturday, with temperatures falling into the cold category.
Isolated heavy falls of rain, which could lead to localised flooding, are expected over the Peninsula, Boland and Overberg areas on Thursday and Friday.

The South African Weather Service appeals to the public to forward to them any reports or confirmation of significant weather events such as snowfalls, hailstorms, heavy rain, damaging winds etc, when they are observed. Such information can also be used for further research, which will contribute to the improvement of weather predictions for that particular area.

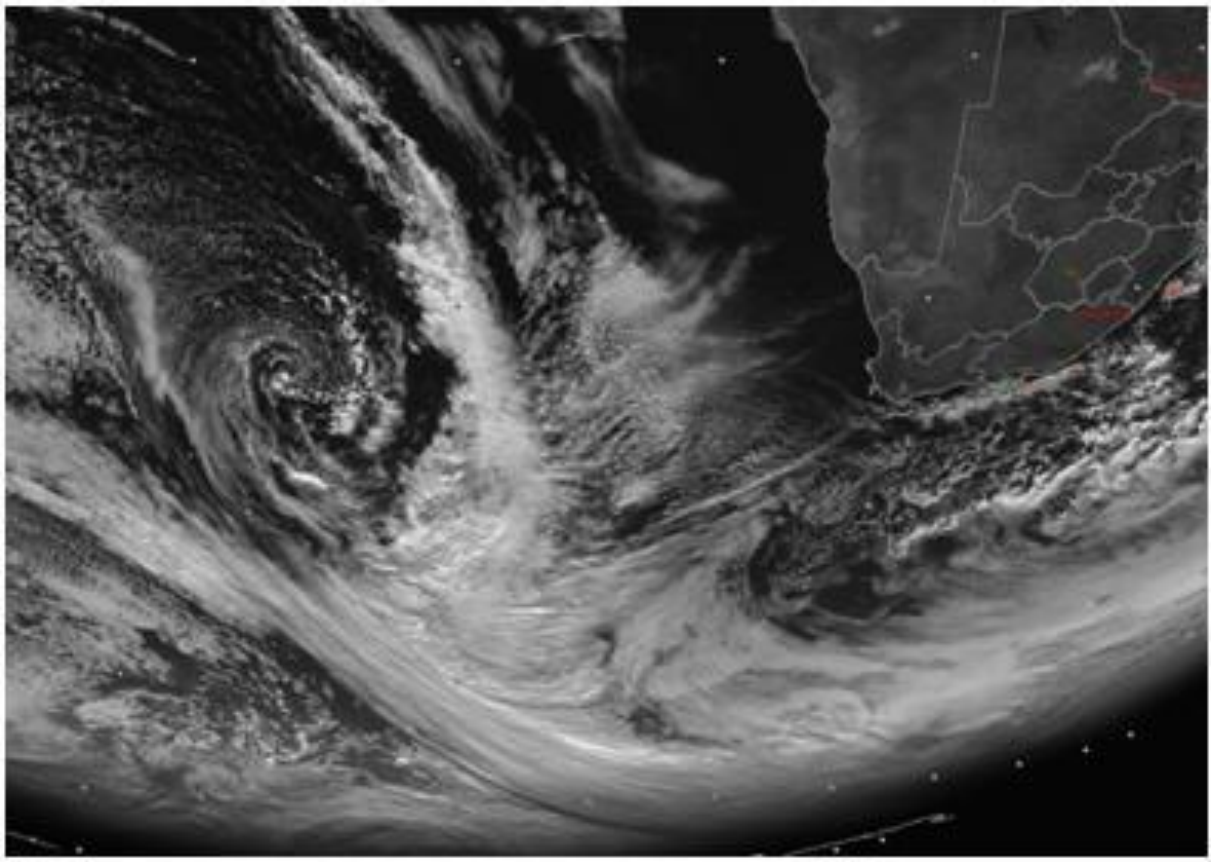


Figure 2.3

QUESTION 2: 5 minutes 10 marks *(Source: DoE November 2009)*

2.1. Refer to FIGURE 1.1 below, showing a simplified synoptic weather map of South Africa. Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A – D) next to the question number (1.1.1 – 1.1.5), for example 1.6 A.

2.1.1 High pressure cell H1 is the ……high pressure

A South Pacific
B South Atlantic
C South Indian
D Kalahari

2.1.2. The following air movements are associated with high-pressure cell H1

A Subsidence, convergence, clockwise rotation
B Uplift, divergence, anticlockwise rotation
C Uplift, convergence, clockwise rotation
D Subsidence, divergence, anti-clockwise rotation

2.1.3. Low pressure cell L1 is in the …… stage of development

A polar front / initial
B wave
C warm sector / mature
D occlusion

2.1.4. The lines on the synoptic weather map linking places of equal pressure are known as?

A isobars
B isotherms
C isohyets
D isotopes

2.1.5. Low pressure cell C2 is a / an ….. low pressure

A coastal
B tropical
C extra-tropical
D equatorial

5 x 2 = **[10]**

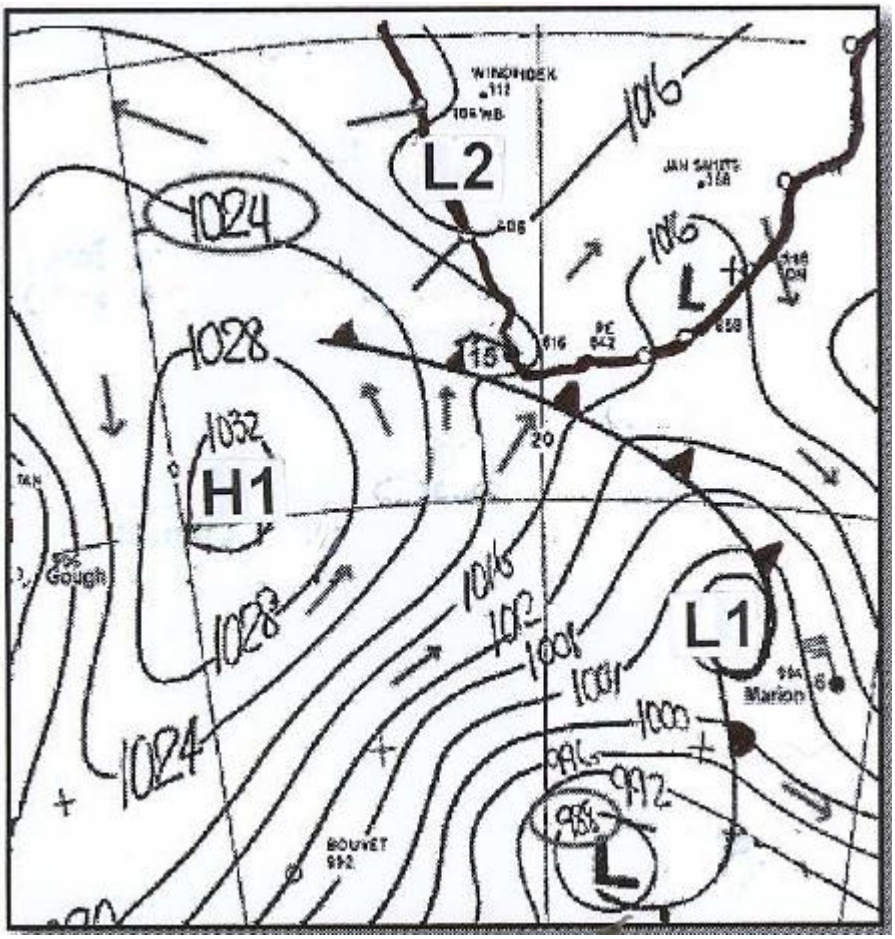


Figure 1.1

SECTION D: SOLUTIONS AND HINTS TO SECTION A: TOPIC 2

QUESTION 1

1.1.1 (a) Presence of cold and warm fronts ✓✓ (1 x 2) (2)

(b) Q ✓✓ (1 x 2) (2)

(c) Furthest east ✓✓ (1 x 2) (2)

1.1.2 (a) Cold front is passing over ✓✓
Cold air mass (sector) follows cold front ✓✓
Cold air forces warm air ahead of it to rise ✓✓
Rising air condenses resulting in cloud formation and rain ✓✓ (4 x 2) (8)

(b) Clouds ✓✓ (1 x 2) (2)

(c) Possible flooding and people should evacuate ✓✓
Snowfall and very cold conditions and people must find shelter ✓✓
Stock up on food/medical supplies ✓✓
Purchase lamps/candles in case power is cut ✓✓
Put sandbags down to prevent water coming in ✓✓ [Any ONE] (1 x 2) (2)

[18]

QUESTION 2

2.1

2.1.1 True ✓✓
2.1.2 True ✓✓
2.1.3 False ✓✓
2.1.4 False ✓✓
2.1.5 False ✓✓ (5 x 2) **[10]**

QUESTION 3

3.1.1 Prepare for possible damage ✓✓
Evacuation procedures can be put in place ✓✓
Save lives ✓✓ [**Any TWO**. Accept other logical reasons] (2 x 2) (4)

3.1.2 Flooding ✓✓
Soil erosion ✓✓
Destruction of natural ecosystems ✓✓
Loss of natural habitat for animals ✓✓
Veld fires destroy vegetation ✓✓
Destruction of coastline ✓✓
Damage to coastal dunes ✓✓
Loss of agricultural land ✓✓
Snow / low temperatures result in loss of livestock ✓✓
Destruction of infrastructure ✓✓
Destruction of homes ✓✓ **[Any TWO]** (2 x 2) (4)

3.1.3 Co-ordinate rescue attempts ✓✓
Organise air-lifts ✓✓
Set up emergency services ✓✓
Provide food and water ✓✓
Provide health care ✓✓
Set up shelters ✓✓ [**Any TWO.** Accept other logical measures] (2 x 2) (4)

[12]

QUESTION 4

4.1.1 Coastal low ✓✓ (1 x 2) (2)

4.1.2 Cold ocean (cold Benguela current) therefore lack of moisture and the air is cold ✓✓
Diverging air subsides and is dry✓✓ **[Any ONE]** (1 x 2) (2)

4.1.3 C ✓✓ (1 x 2) (2)

4.1.4 It is further east ✓✓
C in occluded stage ✓✓ **[Any ONE]** (1 x 2) (2)

4.1.5 Cyclone/depression family ✓✓ (1 x 2) (2)

4.1.6 It brings much needed rain in winter ✓✓
Allows for the planting of winter crops ✓✓
Low temperatures advantage fruit farming/viticulture ✓✓
Snow could impact negatively on people and crops ✓✓
Flooding could cause destruction/death ✓✓ [**Any TWO]** (2 x 2) (4)

4.1.7 Move south-easterly ✓✓
Merge with mid-latitude cyclone ✓✓
Weakens/dissipate ✓✓ **[Any ONE]** (1 x 2) (2)

[16]

TOPIC 2: TROPICAL CYCLONES

SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: 25 minutes 36 marks *(Exemplar 2008)*

1.1 Refer to the extract as well as the satellite images of tropical cyclone Favio in FIGURE 1.2 and answer the questions that follow:

1.1.1	(a)	Is tropical cyclone Favio an example of a low-pressure or a high-pressure system?	(1 x 2)	(2)
	(b)	With reference to the figure below, give ONE reason to support your answer to QUESTION 1.1.1(a).	(1 x 2)	(2)
	(c)	What was the general direction of movement of tropical cyclone Favio?	(1 x 2)	(2)
1.1.2	(a)	Explain why theTropical cyclone will move in the direction you have mentioned in 1.1.1(c)	(1 x 2)	(2)
	(b)	Explain how the position of the cyclone has changed on the two sattellite imags.	(2 x 2)	(4)
	(c)	What does one call the centre of a tropical cyclone that is clearly visible on the satellite images?	(1 x 2)	(2)
1.1.3	(a)	Name ONE weather condition that is typical of the centre of a tropical cyclone.	(1 x 2)	(2)
	(b)	Explain why the weather condition mentioned in QUESTION 1.1.3(a) exists in the centre of a tropical cyclone.	(2 x 2)	(4)
	(c)	'Favio is now an overland depression …' What stage in the development of a tropical cyclone is being referred to here?	(1 x 2)	(2)
1.1.4	(a)	Fully explain why the stage of development mentioned in QUESTION 1.1.3(a) was reached.	(3 x 2)	(6)
	(b)	Name TWO ways in which tropical cyclone Favio caused damage to the environment once it moved over Mozambique.	(2 x 2)	(4)
1.1.5		Explain why there is a need to establish well-equipped tropical cyclone warning centres in Mozambique.	(2 x 2)	(4)

[36]

Tropical cyclone Favio causing multiple disasters in Mozambique!

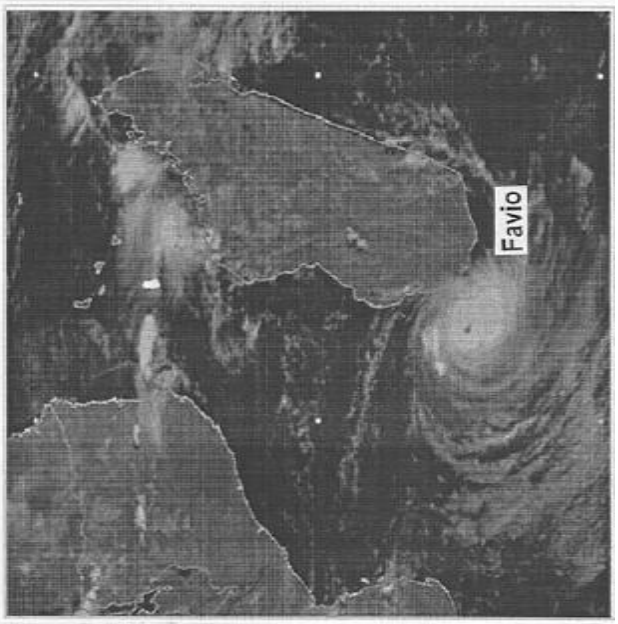
Track and Impact

Tropical cyclone Favio developed in the western Indian Ocean about 1 200 km from Madagascar on 14 February 2007. It gradually moved southwest, passing well off-shore of Reunion and Mauritius. By 20 February, it was just off the southern shore of Madagascar as a well-formed, mature storm. While the storm system had largely skirted around populated areas to that point, forecasters were concerned about its behaviour when it entered the warmer water of the Mozambique Channel.
The storm was turning around the southern end of Madagascar, heading for the Mozambique Channel. Favio had a recognisable shape with spiral arms showing its clockwise rotation. The spiral arms were well-defined and tightly wound. The distinct centre of the storm was only partially filled with clouds. These were all signs of a well-developed tropical cyclone.
Tropical cyclone Favio struck the southern part of Mozambique on Thursday 22 February 2007 bringing in large-scale devastation and suffering to tens of thousands of residents.

Current Conditions and Expected Developments – 23 February 2007

Favio has now transformed from being a tropical cyclone to a tropical depression. This is always the case when a tropical cylcone moves over the land. Favio is now an overland depression. The maximum wind speed is about 60 km/h and is being disorganised gradually.

Satellite Image – 20 February 2007



Satellite Image – 22 February 2007

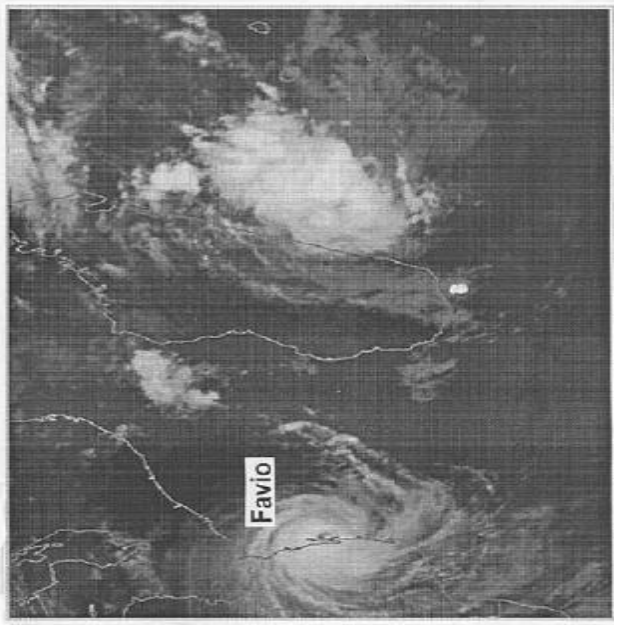


FIGURE 1.2

HINTS

Hint 1: Tropical cyclones are often asked in the form of case studies

Hint 2: Apply your knowledge to the specific situation sketched in the case study

QUESTION 2: 10 minutes 16 marks *(Source: DoE November 2010)*

2.1. Study the information on tropical cyclone Fanele in FIGURE 2.3 on the following page before answering the questions below.

2.3.1 State ONE condition that would have favoured the initial development of tropical cyclone Fanele. (1 x 2) (2)

2.3.2 Give ONE piece of evidence from the satellite image to suggest that tropical cyclone Fanele is in its mature stage. (1 x 2) (2)

2.3.3 Why does tropical cyclone Fanele generally move from east to west? (1 x 2) (2)

2.3.4 Explain why tropical cyclone Fanele weakens when it moves over the southern highlands of Madagascar. (2 x 2) (4)

2.3.5 What was the duration of tropical cyclone Fanele? (1 x 2) (2)

2.3.6 Give TWO reasons why the impact of tropical cyclones on human life is more severe in developing than in developed countries. (2 x 2) (4)

[16]

Tropical cyclone Fanele leaves trail of destruction in Madagascar

For several days in the middle of January 2009, a very weak low-level circulation persisted in the Mozambique Channel. Environmental conditions favoured the rapid development of the cyclone. Fanele quickly strengthened, developing an eye feature late on 19 January.

Fanele slammed into Madagascar in the early hours of Wednesday morning at wind speeds of up to 260 kilometres per hour. As it passed over the southern highlands it weakened quickly over the land. Within four hours of moving ashore its wind speed decreased and the eye feature dissipated.

Formed	18 January 2009
Dissipated	23 January 2009
Highest winds	185 km/h (115 mph) (10 minutes sustained) 185 km/h

FIGURE 2.3

HINTS

Hint 1: You must be able to identify a tropical cyclone on a synoptic weather map as well as satellite images.

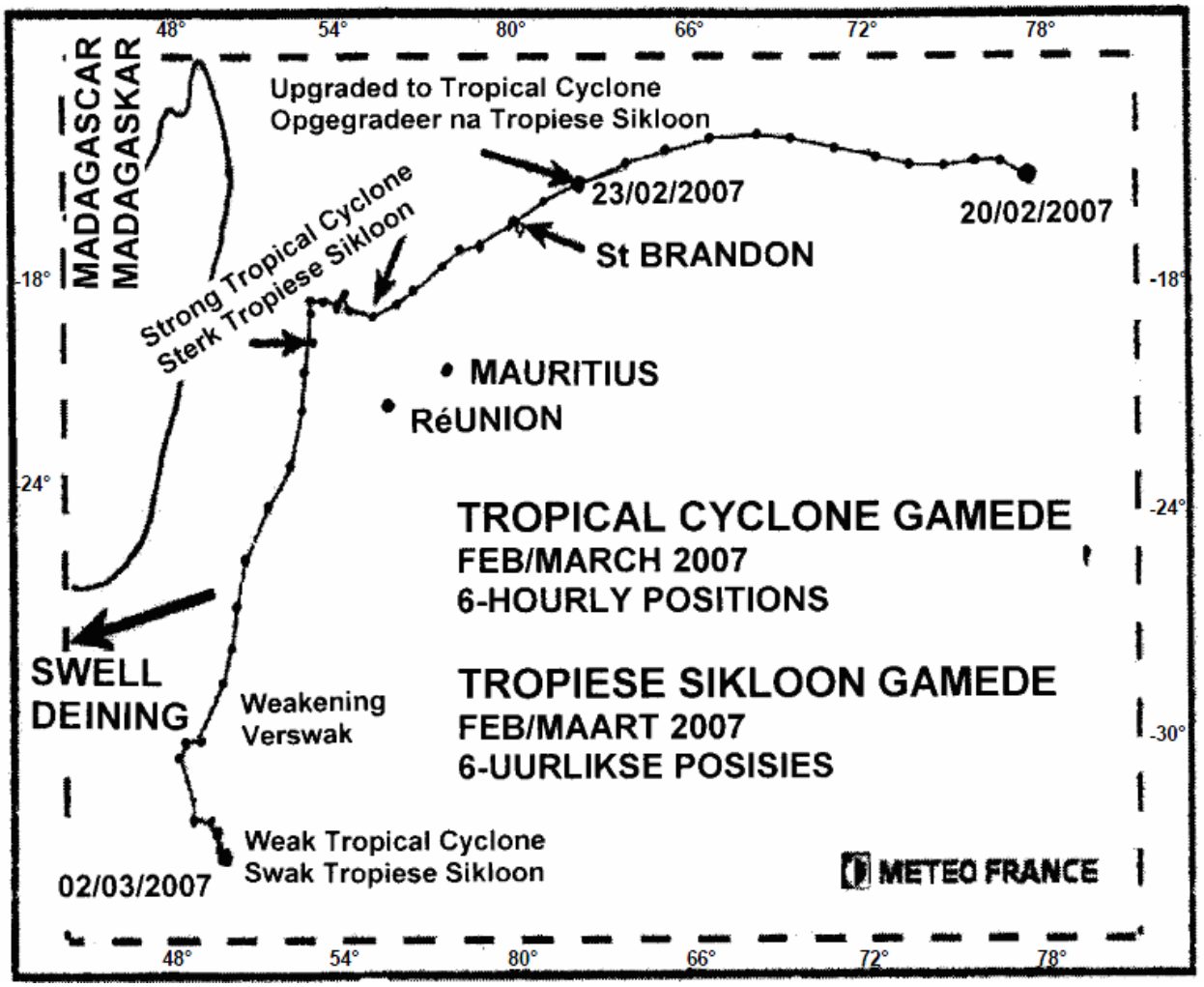
Hint 2: The area where the cyclone occurs is given away by the name, e.g. Hurricane Ann will occur over the Gulf of Mexico and the Caribbean Sea.

QUESTION 3: 10 minutes 18 marks *(Source: DoE Prelim 2008)*

3.1. Refer to the extract that follows, as well as the figure on the next page showing a map of the path taken by Tropical Cyclone Gamede.

THE LEGACY OF TROPICAL CYCLONE GAMEDE, 12 MARCH 2007

Tropical Cyclone Gamede reached speeds of between 116 km/h and 200 km/h in the regions of Mauritius and Réunion. The Meteorological Weather Service of Mauritius sent out early warnings which some people ignored and this resulted in the loss of life. Heavy swells were experienced on the coast of KwaZulu-Natal. The port of Durban was closed for two days. The huge swells flooded the lower Marine Parade and beaches had to be closed due to shark nets being tangled up by the heavy seas.



3.1.1 (a) Before Tropical Cyclone Gamede, how many tropical cyclones occurred in this area during the 2007 tropical cyclone season? (1 x 2) (2)

(b) Give ONE reason for your answer to QUESTION 3.1.1(a). (1 x 2) (2)

(c) Describe the path (direction) taken by Tropical Cyclone Gamede, as illustrated in the map above. (1 x 2) (2)

(d) Is the path taken by Tropical Cyclone Gamede predictable? (1 x 2) (2)

(e) Explain ONE consequence of your answer to QUESTION 3.1.1(d) for people living in areas that have a high frequency of tropical cyclones occurring. (1 x 2) (2)

3.1.2 (a) Name ONE effect Tropical Cyclone Gamede had on the KwaZulu-Natal coastline. (1 x 2) (2)

(b) Name ONE precautionary measure that the residents along the coast of KwaZulu-Natal can take to reduce the adverse effects of tropical cyclones. (1 x 2) (2)

(c) Taking your answers to QUESTIONS 3.1.2(a) and (b) into account, explain the possible effects Tropical Cyclone Gamede had on the local economy of KwaZulu-Natal. (2 x 2) (4)

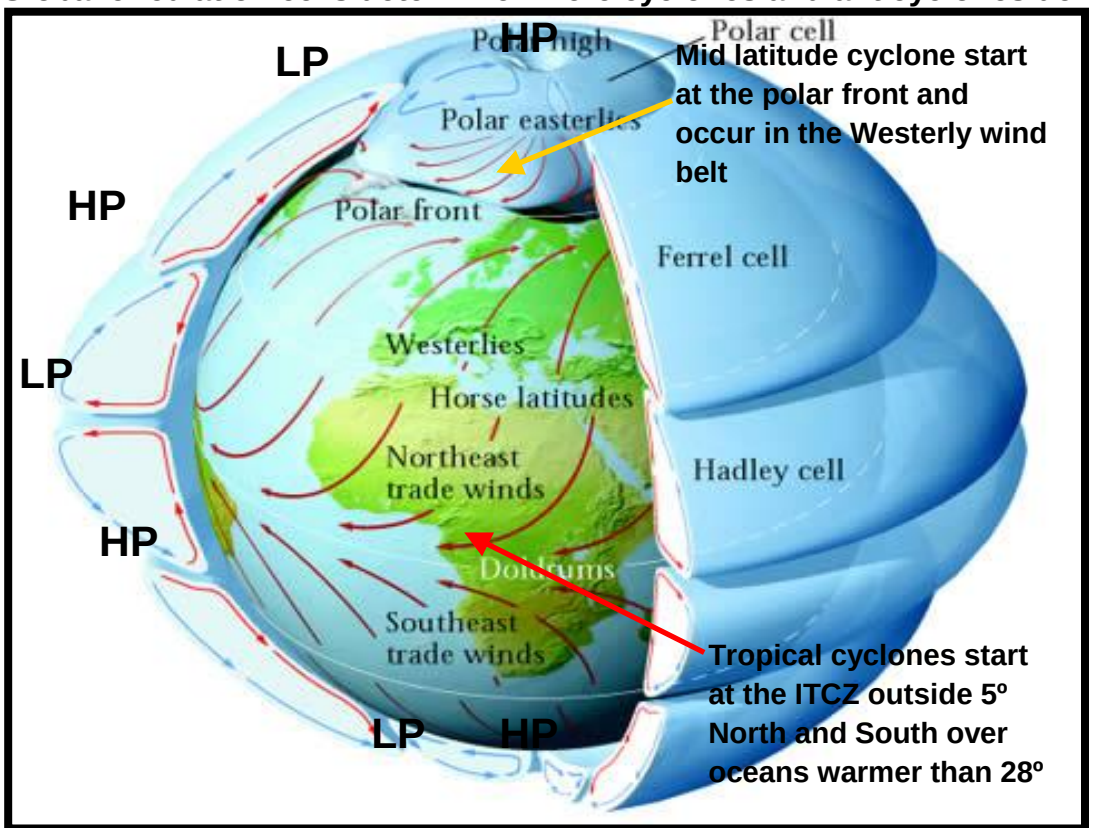
[18]

SECTION B: ADDITIONAL CONTENT NOTES

1. INTRODUCTION

Tropical cyclones develop at the ITCZ, but outside 5º north and south, because a Coriolis force is absent on the equator. It is an intense low pressure storm which causes a lot of wind and flood damage. Tropical cyclones only form under very specific conditions. They are named alphabetically in the season they occur.

Global circulation cells determine where cyclones and anticyclones develop.



2. TROPICAL CYCLONES

Tropical cyclones develop over the sea in the tropical areas. The water must be warmer than 28ºC which leads to a lot of evaporation and very hot, humid, unstable air. The hot air starts rising and forms an intense low pressure on the surface. The tropical jet stream in the upper air causes an upper air low pressure and this intensifies the low pressure on the surface. Air is sucked into the low pressure. If this happens outside 5ºN and S, Coriolis force will cause the winds to spiral towards the low pressure. This intensifies the low pressure to such an extent that a clear funnel, called the eye of the cyclone, develops. The large scale condensation releases latent heat in the atmosphere which makes the air more unstable and contributes to more rising. This causes large cumulonimbus clouds to form, and torrential rain. The air pressure is so low that some air is sucked down in the middle to form this clear, calm, cloudless eye where the air is warmer due to adiabatic heating.
Tropical cyclones are named alphabetically in the season as they develop.

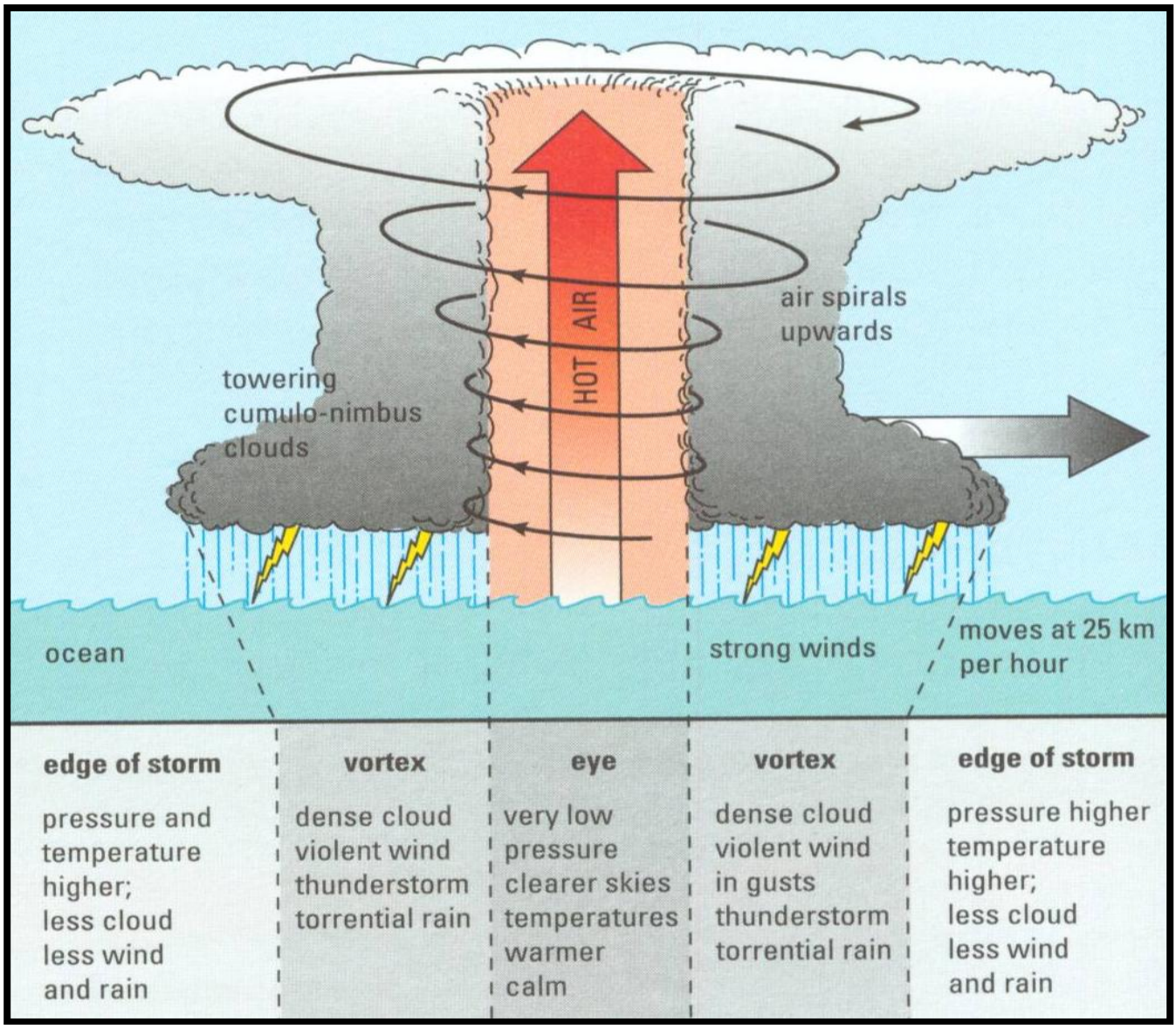
2.1. STAGE 1: FORMATIVE STAGE

In the formative stage the cyclone has very strong up draughts and the low pressure intensifies. The cyclone is not very large yet and there is no clear eye yet. The winds start spiralling.

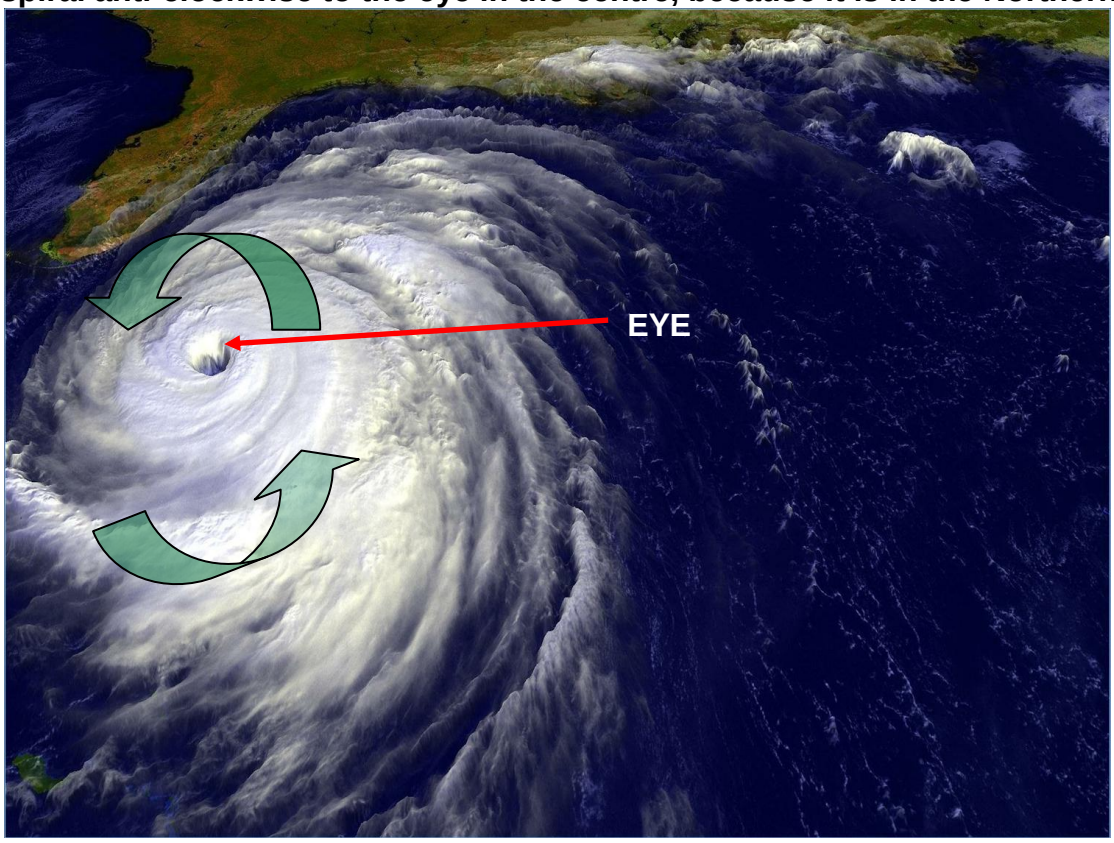
2.2. STAGE 2: MATURE STAGE

The pressure gradient is very strong and wind speeds reach hurricane strength. The calm, clear eye is well developed and the air pressure is less than 950hPa. The South Western quadrant is the most destructive as the winds and the Tropical Easterly winds are coinciding. The cyclone can cover distances of up to 300km from the eye. The cyclone moves in a South Westerly direction from the equator and then turns South East at about 20º South. The low pressure and the fast wind over the ocean masses cause a storm surge (bulge of sea water) which leads to further flooding of the coastal areas hit by the cyclone.

A cross section of a tropical cyclone in the southern hemisphere - the winds move clockwise up around the eye



Here is a satellite image of a hurricane over the Gulf of Mexico. Notice that the winds spiral anti-clockwise to the eye in the centre, because it is in the Northern hemisphere



2.3. STAGE 3: DISSIPATING STAGE

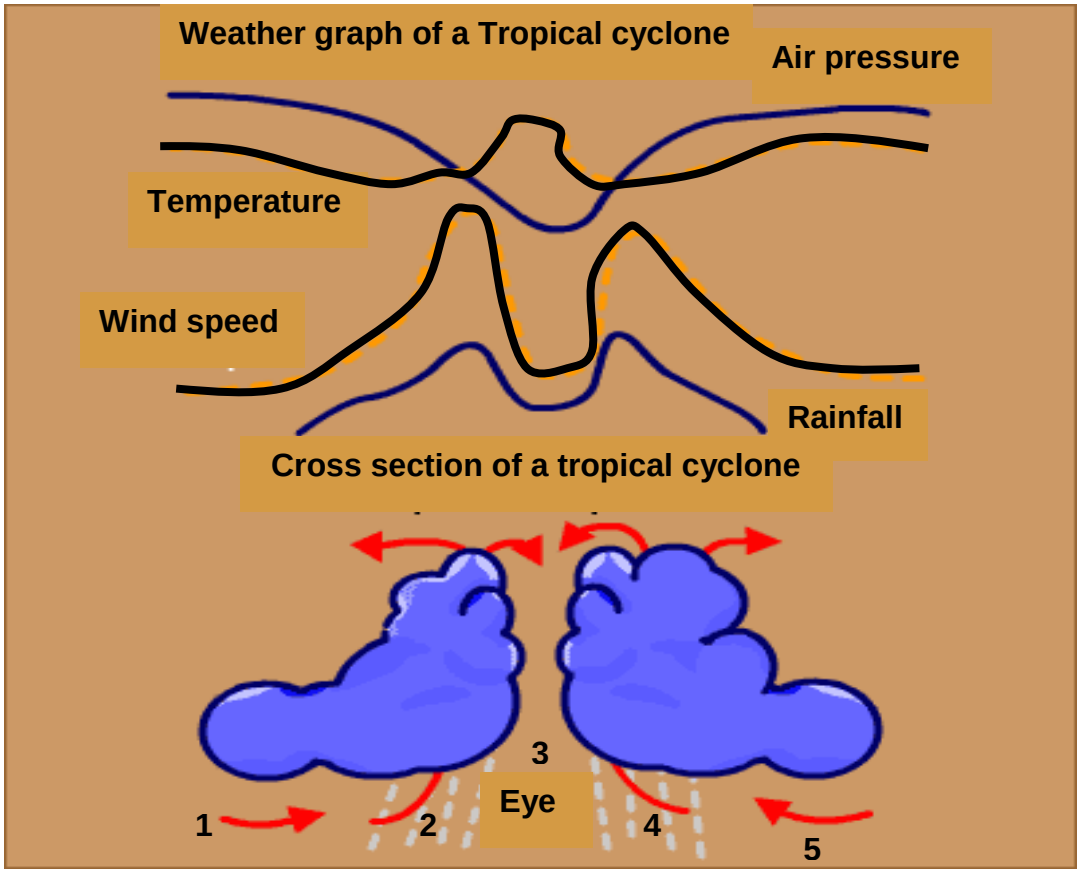
When the tropical cyclone moves over land, the wind is slowed down by friction and there is less evaporation to cause unstable air conditions. The cyclone also moves into cooler sub-tropical areas and the air pressure increases. The weather clears up.

Consequences of Tropical cyclones

- Heavy rain
- Flooding of islands and coastal areas
- Loss of livestock, and crops on farms
- Destruction of infrastructure
- Contamination of water sources and disease
- Erosion due to flooding
- Dangerous conditions on sea due to large waves and strong winds
- Isolation due to communication structures that are destroyed

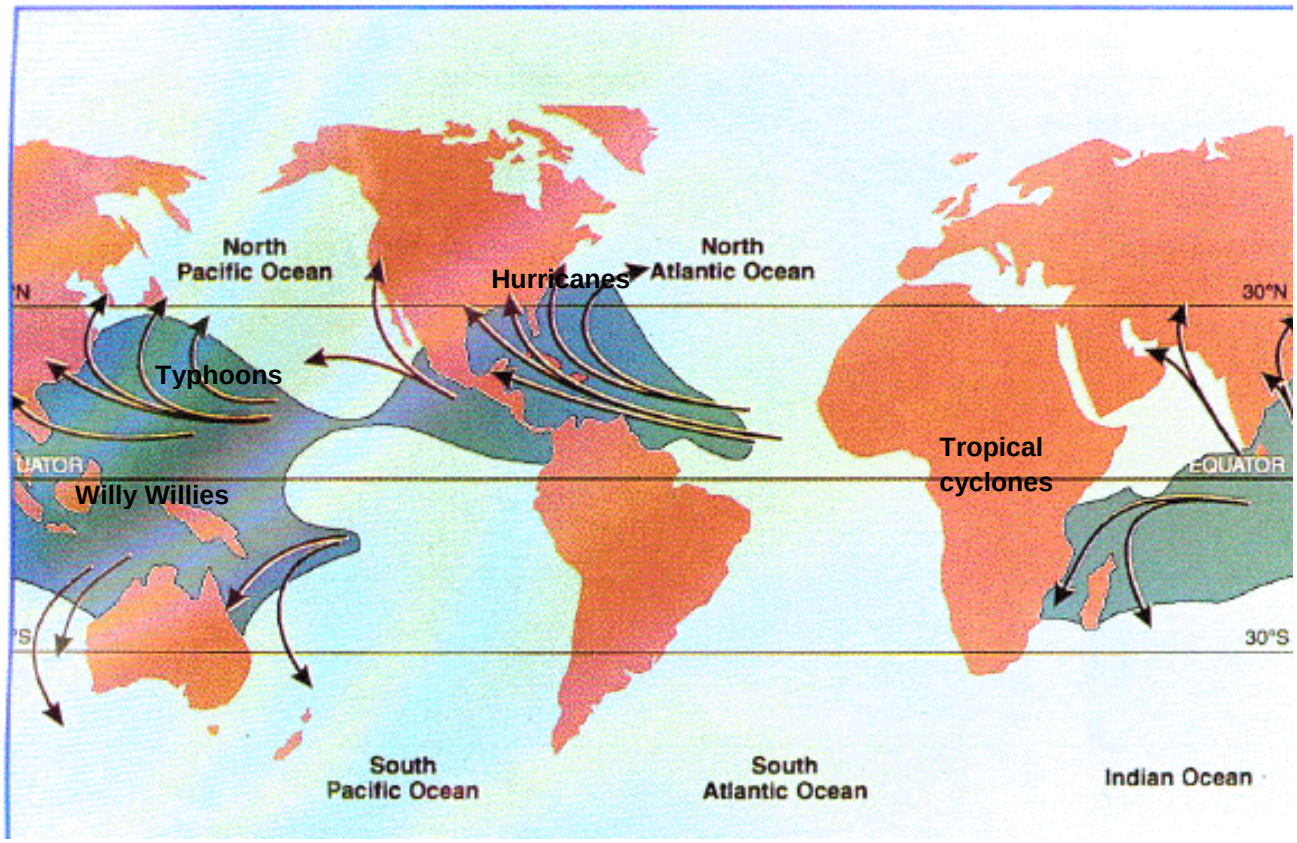
2.4. WEATHER ASSOCIATED WITH A TROPICAL CYCLONE

	1	2	3	4	5
Air pressure	Dropping	Drops	< 950hPa	Rises but still low	normalises
Temperature	± 26ºC	Drops due to cloud cover	Rises to ± 28ºC due to adiabatic heating in eye	± 26ºC	normalises
Wind speed	Fast	Hurricane strength winds – Strongest in cyclone	Calm in eye	Hurricane strength winds	Slow down and Normalises
Rainfall	Light rain	Torrential rain	Clear up	Torrential rain	Softer rain that clears up



Look at the following map. The darker blue water indicates where the oceans are warm enough for tropical cyclones to develop. Notice that the South Western Atlantic Ocean never experiences tropical cyclones. This ocean mass never becomes warm enough for tropical cyclones to develop. Cyclones have different names in different areas in the world: Willy-Willies in Australia, Tropical Cyclones in the Indian Ocean, Hurricanes in the North America and Typhoons in Japan and China.

Where tropical cyclones occur - more arrows indicate a higher frequency.



SECTION C: HOMEWORK

QUESTION 1: 20 minutes 28 marks *(Source: DoE November 2009)*

HURRICANE IKE

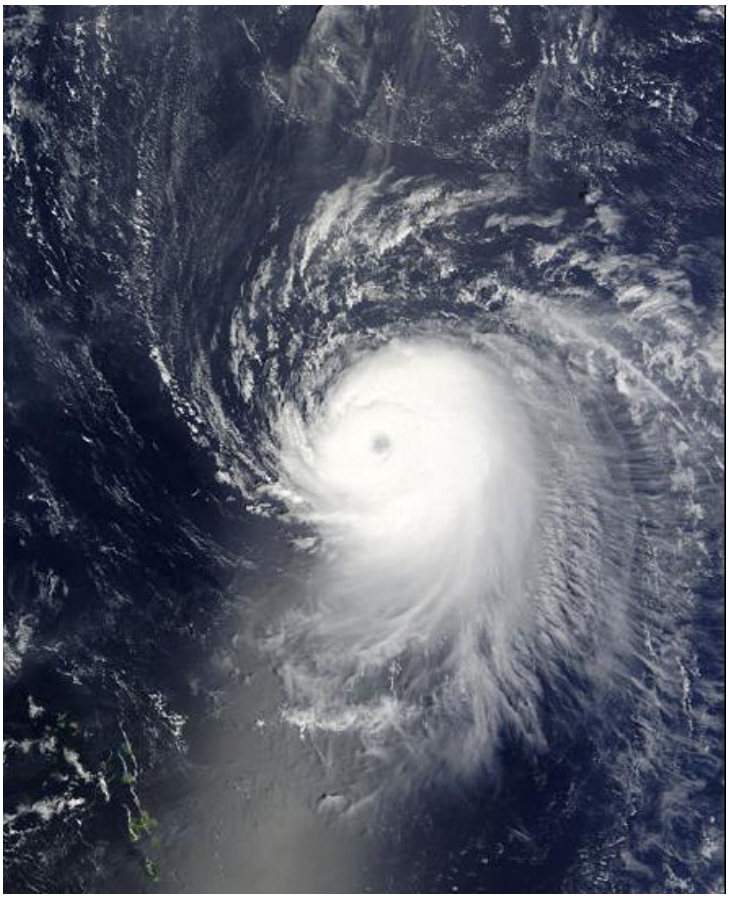
On 10 September, US President George W Bush made an emergency declaration for Texas in advance of Hurricane Ike, making more federal help available for preparations and evacuations.

State rural water associations activated mutual aid networks to prepare for the landfall of Hurricane Hanna and Hurricane Ike while still providing assistance to areas impacted by Hurricane Gustav. The Texas Rural Water Association held meetings with state agencies on Tuesday, 9 September, to plan for landfall along the Texas gulf coast.

On 11 September, forecasting models began to show Ike making landfall just south of Galveston. City Manager Steve LeBlanc issued a mandatory evacuation order late Wednesday for the low-lying west end of Galveston Island. Later, the mandatory evacuation order was extended to the entire island of Galveston, as well as low-lying areas around Houston, Texas.

Also on 11 September, at 20:19, the National Weather Service in Houston/Galveston, issued a strongly worded bulletin, regarding storm surge along the shoreline of Galveston Bay. The bulletin advised that residents living in single-family homes in some parts of coastal Texas may face "certain death" if they did not heed orders to evacuate. Reports said as many as 40 percent of Galveston's citizens may not have paid attention to the warnings. It was feared to be much the same in Port Arthur.

Hurricane Ike was the ninth named storm, fifth hurricane and third major hurricane of the 2008 Atlantic hurricane season. The satellite image that follows shows Hurricane Ike at peak intensity.



Hurricane Ike

1.1. The map on the following page represents a section of the world map showing the location and movement of tropical cyclones/hurricanes in the South Indian Ocean and the West Indies respectively. Also refer to the article and satellite image of Hurricane Ike above.

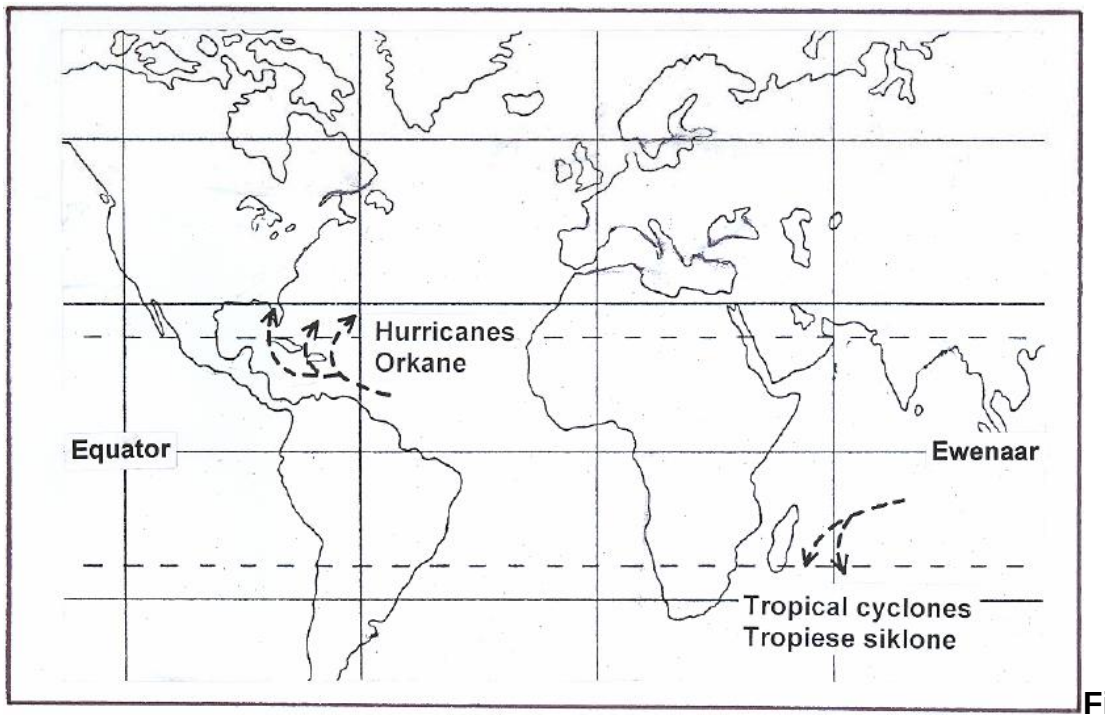


Figure 1.3A

1.1.1 Give ONE similarity, visible in the figure above, between tropical cyclones in the South Indian Ocean and hurricanes in the West Indies. (1 x 2) (2)

1.1.2 Explain the point of origin of both tropical cyclones and hurricanes. (3 x 2) (6)

1.1.3 Very intense hurricanes, such as Ike, occur more often and more regularly. Many meteorologists link the latter with global warming. Why is this so? (3 x 2) (6)

1.1.4 With reference to FIGURE 1.3A, give ONE reason why tropical cyclones seldom hit the coast of southern Africa. (1 x 2) (2)

1.1.5 Should a tropical cyclone and a hurricane of similar strength hit the of southern Africa and the United States of America respectively, the United States of America would suffer more damage to infrastructure, while southern Africa would experience more loss of life. Write a short essay (no more than 12 lines) to explain why this is the case. Your answer should refer to the level of development in the two regions respectively. (6 x 2) (12)

[28]

QUESTION 2: 15 minutes 24 marks *(Source: DoE November 2008)*

2.1. You are a weather detective and you are asked to investigate some of the changing weather patterns southern Africa has been experiencing recently. Use the figure on the following page to assist you to answer the questions below.

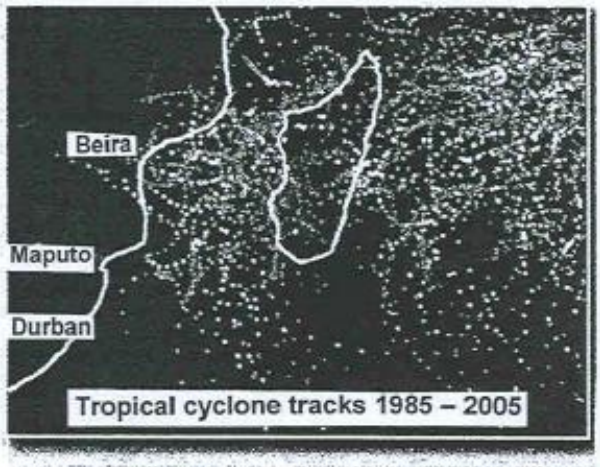
WHY SUCH FLOODS?

Adapted from Liesl Dyson
(University of Pretoria)

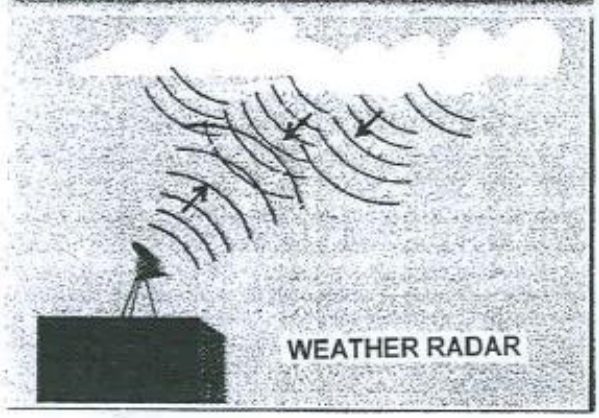
The Mozambican floods that killed some 40 people and displaced 280 000 were caused by tropical cyclone Favio, which made landfall on the coast on 22 February 2007. The eye in the centre of the cyclone is a relatively calm area where the atmospheric pressure is lowest. The minimum pressure that occurred during Favio's lifetime is estimated to have been 930 hPa. This very low pressure caused Favio to be fierce enough to be classified as an 'intense tropical cyclone'. A tropical cyclone is 'intense' when the surface winds' strengths are 110 – 210 km/h.

Tropical cyclones are not rare in the southwest Indian Ocean. About 10 occur every year during the summer season, but most frequently between January and February. The statistics show that a tropical cyclone does not make landfall in Mozambique every year, and seldom invades the coast of South Africa – the last time was in 1984, when cyclones Demoina and Imboya caused heavy rainfall over the north coast of KwaZulu-Natal.

In February 2000, tropical cyclone Eline moved in over Mozambique and was responsible for widespread heavy rainfall and flooding. In many ways Eline and Favio are comparable.



Tropical cyclone tracks 1985 – 2005



After the devastating floods in 2000, the Mozambique weather service acquired two weather radars (radar is the acronym for radio detection and ranging) to provide better information. The radar transmitter sends out high-frequency radio waves in pulses. Radar is useful to weather forecasters for locating rain and hail and for identifying severe storms and heavy rainfall. Once they see the potential for heavy rainfall, they issue warnings and people are advised to vacate dangerous areas.

2.1.1 What has been causing the floods in Mozambique over the last few years?
(1 x 2) (2)

2.1.2 Give TWO reasons why Favio has been classified as an intense tropical storm.
(2 x 2) (4)

2.1.3 'Tropical cyclones are not rare in the southwest Indian Ocean.'
State and explain TWO factors that favour the formation of cyclones in this area.
(4 x 2) (8)

2.1.4 Explain why tropical cyclones seldom reach the coast of South Africa.
(2 x 2) (4)

2.1.5 What does the acronym *radar* in the word 'weather radar' stand for? (1 x 2) (2)

2.1.6 Of what value is a weather radar to the following?
(a) Weather forecasters (1 x 2) (2)
(b) People living close to rivers and coasts (1 x 2) (2)
[24]

SECTION D: SOLUTIONS AND HINTS TO SECTION A
TOPIC 2: TROPICAL CYCLONES

QUESTION 1

1.1.1 (a) Low pressure ✓✓ (1 x 2) (2)

(b) Reference to clockwise rotation of air ✓✓
Satellite image shows clockwise spiralling cloud band ✓✓
Reference made to a depression ✓✓
[Any ONE] (1 x 2) (2)

(c) East to West direction ✓✓ (1 x 2) (2)

1.1.2 (a) The cyclone is in the Tropical Easterly wind belt which blows it from East to West. ✓✓ (1 x 2) (2)

(b) On 20/02/2007 it was south of Madagascar and on 22/02/2007 it was just off the east coast of Africa/Mozambique✓✓ (2 x 2) (4)

(c) Eye✓✓ (1 x 2) (2)

1.1.3 (a) Cloudless ✓✓
Wind-still ✓✓
No rain ✓✓
Low pressure ✓✓ [Any TWO] (1 x 2) (2)

1.1.3. (b) Descending column of air in centre heats up ✓✓
No condensation therefore cloudless ✓✓
No rain because there is no condensation ✓✓
Wind-still as air rotates clockwise to isobars around the eye ✓✓
Convergence and rising air results in low pressure ✓✓
[Any TWO] (2 x 2) (4)

1.1.3 (c) Dissipating/Decaying stage ✓✓ (1 x 2) (2)

1.1.4 (a) It has reached the land ✓✓
Cut off from source of moisture ✓✓
Evaporation reduced ✓✓
Less condensation and release of latent heat ✓✓
Friction over land slows system down ✓✓
[Any THREE] (3 x 2) (6)

1.1.4 (b) Soil washed away ✓✓
Natural vegetation destroyed ✓✓
Destruction of farmland ✓✓
Animals drown✓✓ [Any TWO] (2 x 2) (4)

1.1.5 To detect the development of a tropical cyclone in its early stages development ✓✓
To warn people in time of the approaching tropical cyclone ✓✓
Evacuation procedures can be put into place ✓✓
Limit loss of life ✓✓
To put in place measures that will minimise the impact of a tropical cyclone, e.g. rescue operations can be planned ✓✓
[Any TWO - Accept other] (2x 2) (4)
[36]

QUESTION 2

2.1.1 Sea surface temperatures of 26½°C and above ✓✓
Date middle January/late summer ✓✓
Unstable atmospheric conditions (✓✓
Developed between 5º and 20º south of the equator ✓✓
Coriolis force ✓✓
Calm conditions ✓✓
Upper air divergence ✓✓
High rate of evaporation ✓✓
Winds that are light and variable ✓✓
Little friction over the ocean ✓✓ [Any ONE] (1 x 2) (2)

2.1.2 Presence of the eye ✓✓
Cumulonimbus clouds around the eye ✓✓
Air circulation is well established ✓✓
Extent of tropical cyclone/large area covered ✓✓ [Any ONE] (1 x 2) (2)

2.1.3 Is steered by the easterly winds/trade winds in the easterly/trade wind belt ✓✓ (1 x 2) (2)

2.1.4 Lack of moisture ✓✓
Evaporation and condensation decreases ✓✓
Less latent heat released into the system/looses energy ✓✓
Surface wind slows down ✓✓
Friction with the land ✓✓ [Any TWO] (2 x 2) (4)

2.1.5 6 days/18 t0 23 January ✓✓ (1 x 2) (2)

2.1.6 People live below the flood line ✓✓
Developed areas have the technology to monitor and track the movement of the storm ✓✓
Developed areas can issue warnings and plan evacuations to prevent large losses ✓✓
Difficult to coordinate rescue plans because of poor infrastructure ✓✓
Inadequate health facilities ✓✓
Inadequate funding to improve infrastructure/health facilities/technology ✓✓
Intended aid does not reach the victims due to corruption ✓✓
People live in remote areas ✓✓
The government does not give assistance when it comes to rebuilding ✓✓
[Any TWO. Accept any other reasonable answers] (2 x 2) (4)
[16]

QUESTION 3

3.1.1 (a) 6 ✓✓ (1 x 2) (2)

(b) Tropical cyclones are named alphabetically, the tropical cyclone before Gamede would start with the letter F ✓✓ (1 x 2) (2)

(c) Westerly direction then a south-westerly direction and then southerly direction ✓✓ (1 x 2) (2)

(d) No ✓✓ (1 x 2) (2)

(e) It is not easy to predict which areas it will effect ✓✓
It makes it difficult to issue warning signals ✓✓
It causes more damage/loss of life ✓✓
[Any ONE] (1 x 2) (2)

3.1.2 (a) Port of Durban was closed for two days ✓✓
The lower Marine Parade was flooded ✓✓
The beaches had to be closed ✓✓
[Any ONE] (1 x 2) (2)

3.1.2(b) Residents must take warnings seriously ✓✓
Must stock up with food especially canned food ✓✓
Must stock up with water ✓✓
Have battery operated torch and radio ✓✓
Don't use telephone unnecessarily ✓✓
Keep a well-stocked first aid kit ✓✓
[Any ONE – accept any other logical answer] (1 x 2) (2)

(c) The local economy will be damaged ✓✓
Business and industry will come to a virtual standstill ✓✓
A lot of money will be spent to sort out the damages ✓✓
Infrastructure will be damaged which will effect economy ✓✓
Costly insurance claims ✓✓
Negative impact on tourism ✓✓
[Any TWO – accept other logical answers] (2 x 2) (4)
[18]

TOPIC 1: FACTORS THAT INFLUENCE SA WEATHER

Learner Notes: The examiners expect you to know the following:

Factors determining the weather of South Africa

- Influence of the oceans on South Africa's weather
- Effect of the interior plateau on South Africa's weather
- Influence of latitudinal position of the sub-continent on South Africa's weather

Anticyclonic circulation

- Identification of three anticyclones on synoptic charts
  - o South Atlantic / St Helena High
  - o South Indian / Mauritius High
  - o Kalahari / Continental High
- Resultant weather

SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: 15 minutes **20 marks** *(Source: DoE Exemplar 2008)*

1. Refer to the FIGURE 1A below showing the weather forecast for 15 May 2007. FIGURE 1B is a cross-section through the eastern half of the country explaining the sunny conditions at all the inland weather stations.

1.1.1. What is meant by the term *inversion* shown in FIGURE 1B? (1 x 2) (2)

1.1.2 Name the high-pressure cell associated with the label *subsided air of continental origin*. (1 x 2) (2)

1.1.3 Why does an inversion develop at the lower side of the high pressure cell mentioned in QUESTION 1.1.2? (2 x 2) (4)

1.1.4 With reference to FIGURE 1B, explain why sunny conditions are indicated for all the inland weather stations. (3 x 2) (6)

1.1.5 Will the inversion shown in FIGURE 1B be higher or lower than its current position during the summer months? (1 x 2) (2)

1.6 The vertical positional change of the inversion from winter to summer is of great importance to farmers on the South African plateau. Explain this statement. (2 x 2) (4)

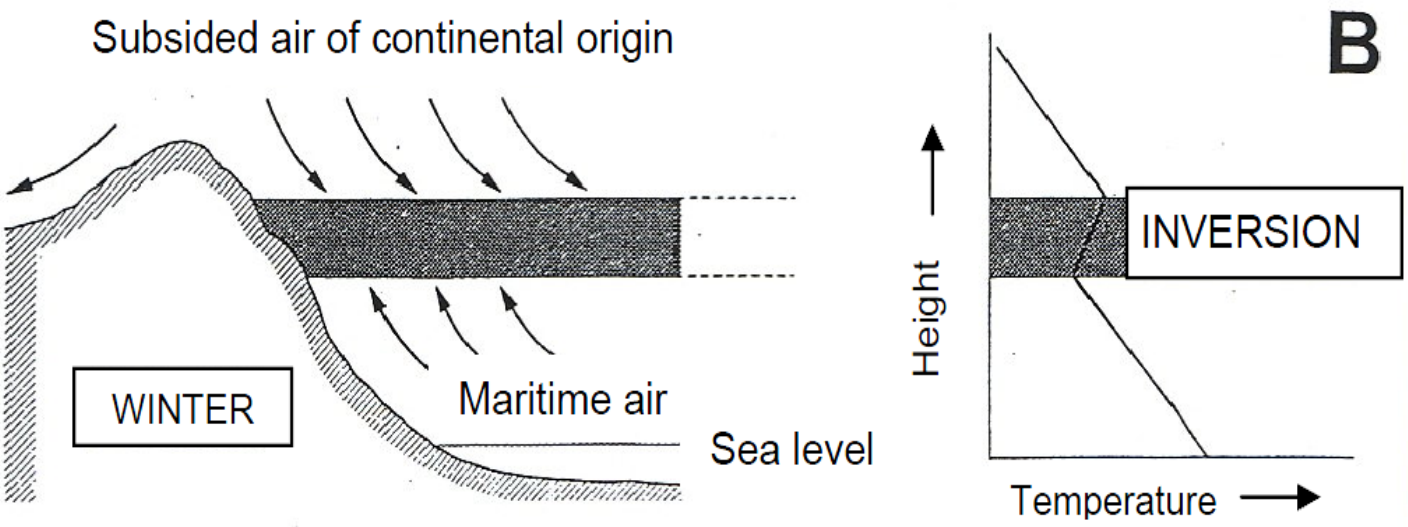
[20]

FIGURE 1A

Main City Weather
Tuesday 15 May 2007

		Min.	Max.
Bloemfontein		7 °C	19 °C
Cape Town		15 °C	19 °C
Durban		15 °C	27 °C
East London		17 °C	24 °C
Johannesburg		13 °C	25 °C
Kimberley		8 °C	19 °C
Mafikeng		10 °C	27 °C
Nelspruit		10 °C	30 °C
Pietermaritzburg		13 °C	26 °C
Polokwane		9 °C	28 °C
Port Elizabeth		14 °C	23 °C
Pretoria		15 °C	27 °C

FIGURE 1B



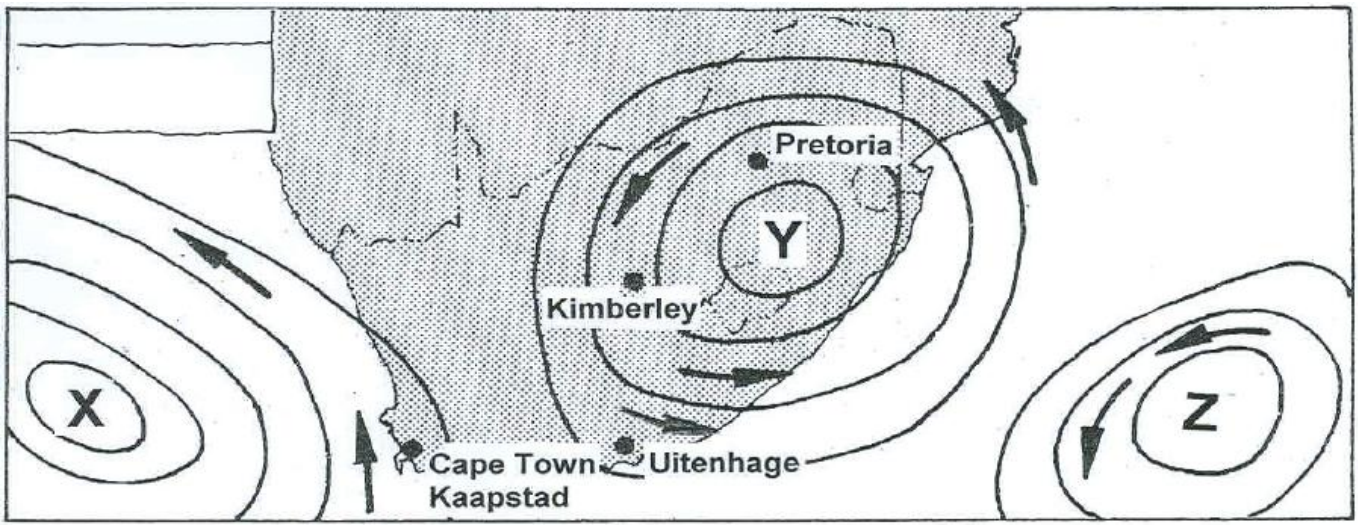
HINTS

Hint 1 - Look at the height of the Inversion layer – if it is below the escarpment, it is winter and if it is above the escarpment, it is summer

Hint 2 – The bigger the difference between maxi mum and minimum temperatures, the drier the air. Water vapour retains heat if the air is dry. Lots of the heat will be lost during the night.

QUESTION 2: 10 minutes 14 marks *(Source: DoE November 2008)*

2.1. Refer to the figure below showing the position of the three high-pressure cells over southern Africa that have major effects on the weather and climate. Berg wind conditions are experienced in the vicinity of Uitenhage.



2.1.1 (a) Identify the THREE high pressure cells labelled X, Y and Z respectively. (3 x 2) (6)

(b) Which ONE of the three high-pressure cells mentioned in QUESTION 2.1.1(a) is mainly responsible for the different weather conditions experienced over the South African interior during summer and winter? (1 x 2) (2)

(c) State and explain ONE difference in the weather conditions experienced during winter and summer over the South African interior by referring to the role played by the high pressure cell mentioned in QUESTION 2.1.1(b). (3 x 2) (6)

[14]

QUESTION 3: 15 minutes 22 marks *(Source: DoE Prelim 2008)*

3.1 Refer to the figure below showing a synoptic weather map of Southern Africa For 16 November 2007.

3.1.1 (a) Identify the weather system labelled **A**. (1 x 2) (2)

(b) Weather system **A** has reached its occlusion stage (cold front occlusion). Draw a clearly labelled cross-section of a cold front occlusion showing the position of the air masses and the cold and warm fronts. (3 x 2) (6)

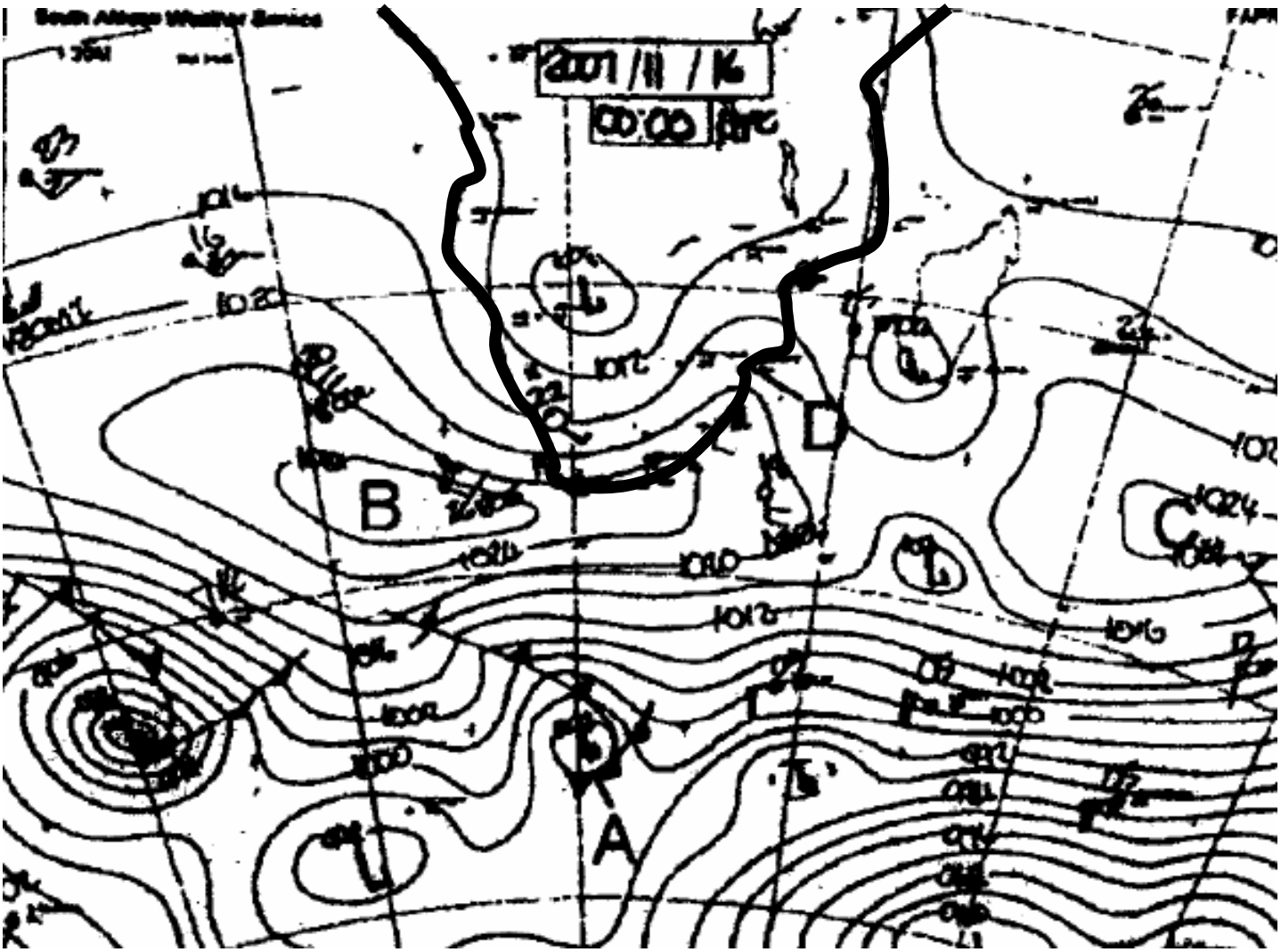
3.1.2 (a) Name the high pressure systems labelled **B** and **C** respectively. (2 x 2) (4)

(b) Explain how high pressure system **B** influenced the weather conditions over the Western Cape. (2 x 2) (4)

3.1.3 (a) Name the high pressure system often found over the interior of South Africa. (1 x 2) (2)

(b) Explain the effect that the high pressure system referred to in QUESTION 3.1.3(a) has on rainfall on the plateau. (2 x 2) (4)

[22]



HINTS:

Hint 1- The High Pressures are named according to where they occur.

Hint 2 - Write the full name of the high pressure, e.g. South Atlantic Ocean High Pressure cell when you need to identify it.

SECTION B: ADDITIONAL CONTENT NOTES

1. WEATHER PATTERNS IN SA

There are 3 factors that influence the climate in South Africa:

- The distance from the Equator, between 22º South and 34º South where the descending Sub-tropical High Pressure cells and clear dry conditions occur.
  - There are three specific high pressure cells that influence the climate and weather of South Africa, namely:
    - The Kalahari HP over the interior which is better developed in winter and which causes a temperature inversion over the plateau in winter. This leads to dry conditions in winter
    - The South Atlantic Ocean HP is over the cold Benguela current and pushes cool dry air over the country in summer.
    - The South Indian Ocean HP is over the warm Aghullas current and pushes warm moist air in over the country in summer. This leads to rainfall.
- The high average altitude of the South African plateau (between 800 m and 1500m) which causes cooler condition than at other places with the same latitude
- The warm Mozambique Ocean current along the east coast which leads to warmer conditions and more rain, and the cold Benguela Ocean current along the west coast which causes dry cool conditions.

1.1. WINTER WEATHER IN SA

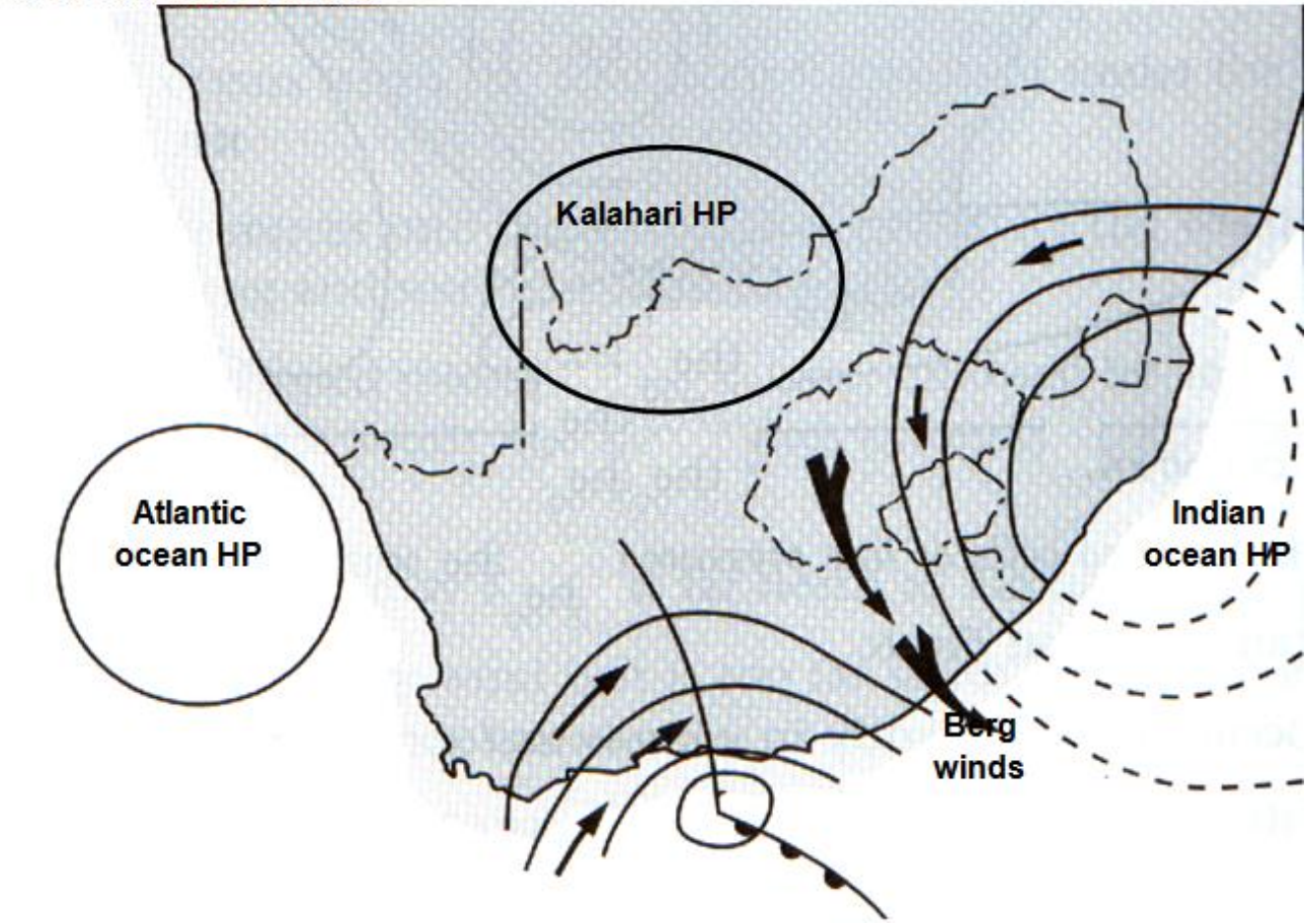
Winter weather in SA is dominated by the Subtropical High Pressure cells over and next to the country. The subsiding air causes a temperature inversion which prevents all the moist maritime air from entering the interior. Clear cool dry conditions persist over the summer rainfall area.

Passing mid-latitude cyclones cause frontal rain over the South Western Cape in the winter rainfall area (Mediterranean area.)

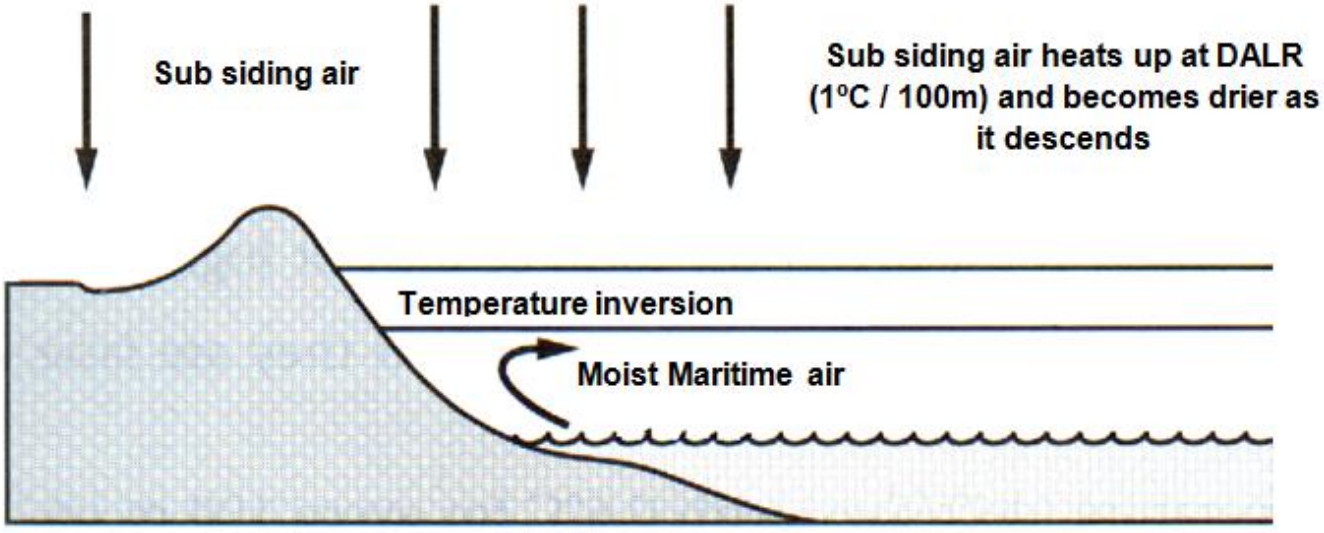
Ahead of the mid latitude cyclone, berg wind conditions occur, where air flows from the Kalahari High Pressure cell to the low pressure over the sea. As the air subsides from the plateau and down the escarpment, it heats at Dry Adiabatic temperature lapse rate and become drier. This causes hot dry uncomfortable conditions in the Southern Cape, which is replaced quickly with cold conditions associated with the cold front.

The subsiding air in the Kalahari High Pressure Cell heats up at Dry Adiabatic lapse rate and is warmer than the air from the coastal areas. This causes a temperature inversion. The subsiding air also prevents any air from entering the interior. Therefore, no rain occurs over the interior in winter.

Winter conditions in SA.



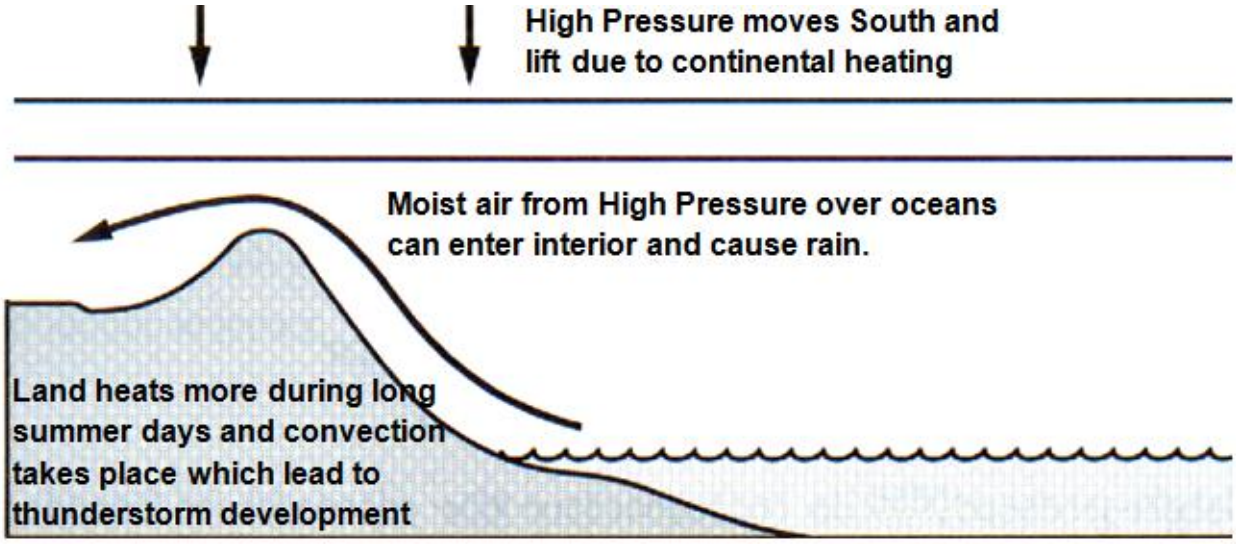
The temperature inversion sinks below the escarpment and prevents any moist air from entering the central plateau.



SUMMER WEATHER IN SA

In summer the Sub tropical High pressure belt moves south with the Heat Equator. The subsiding air masses and clear conditions shift to south of the country. Moist tropical air masses bring in humid air over the interior which causes summer rain at the moisture front along the centre of the country. Low pressures occur over South Africa.

Summer conditions over SA



SECTION C: HOMEWORK

QUESTION 1: 10 minutes 14 marks *(Source: DoE November 2009)*

1.1. The Kalahari high-pressure cell causes a subsidence inversion over the South African interior. The base height of this subsidence inversion varies from summer to winter. The figure on the following page is a cross-section that shows how the base height of the subsidence inversion varies from summer to winter.

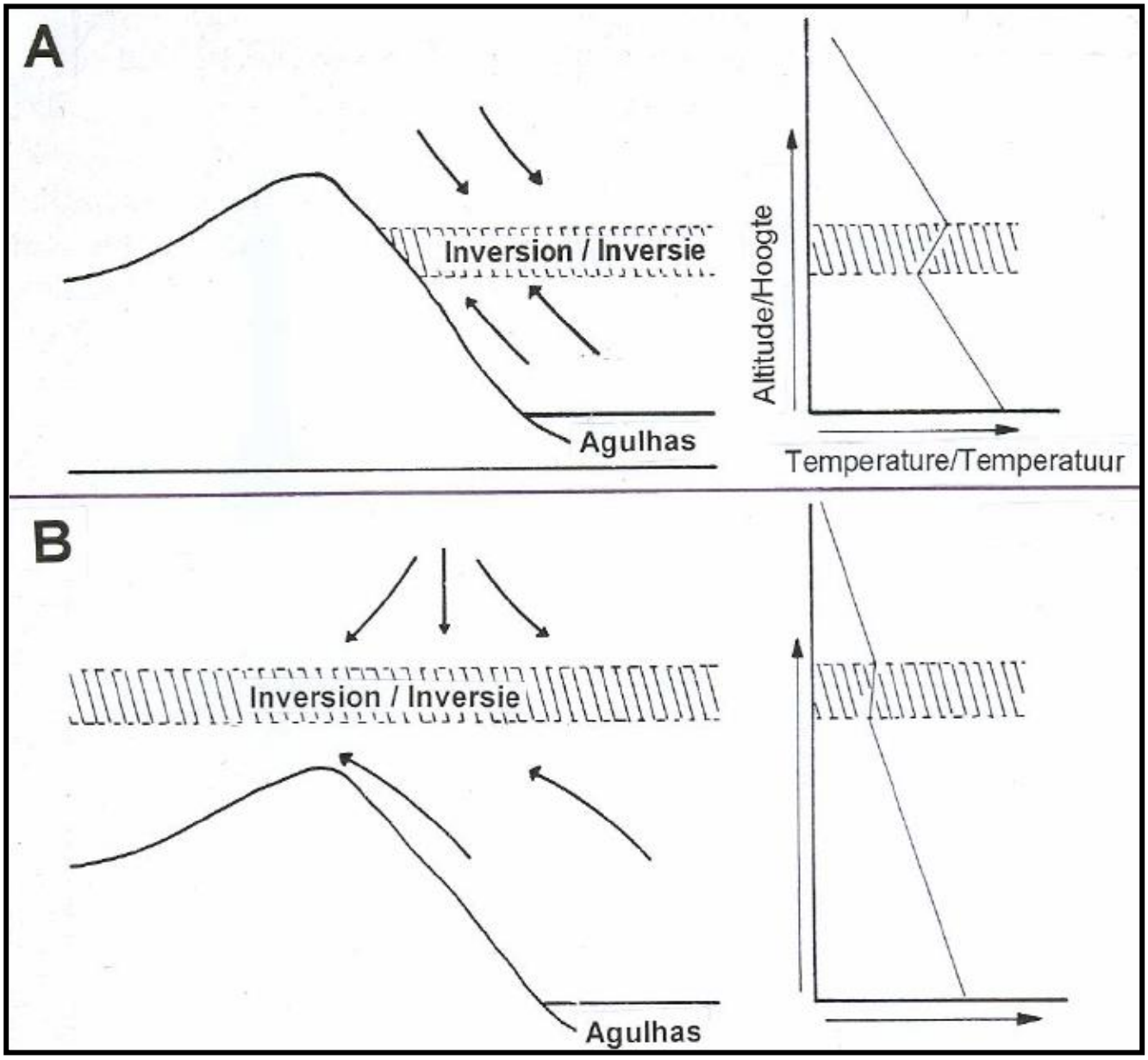
1.1.1 Define the term temperature inversion. (1 x 2) (2)

1.1.2 Which of the diagrams, FIGURE A or B, represents summer months? (1 x 2) (2)

1.1.3 Give ONE reason for your answer to QUESTION 1.1.2. (1 x 2) (2)

1.1.4. Describe the effect that the base height of the subsidence inversion will have on the climate of the South African interior during summer and winter months respectively. (4 x 2) (8)

[14]



QUESTION 2: **5 minutes** **10 marks** *(Source: DoE March 2009)*

2.1 Refer to the figure on the following page, and extract from a synoptic weather chart. Choose the correct term(s) from those given in brackets to make EACH of the statements below TRUE. Write only the term(s) next to the question number (2.1.1 – 2.1.5) as an ANSWER.

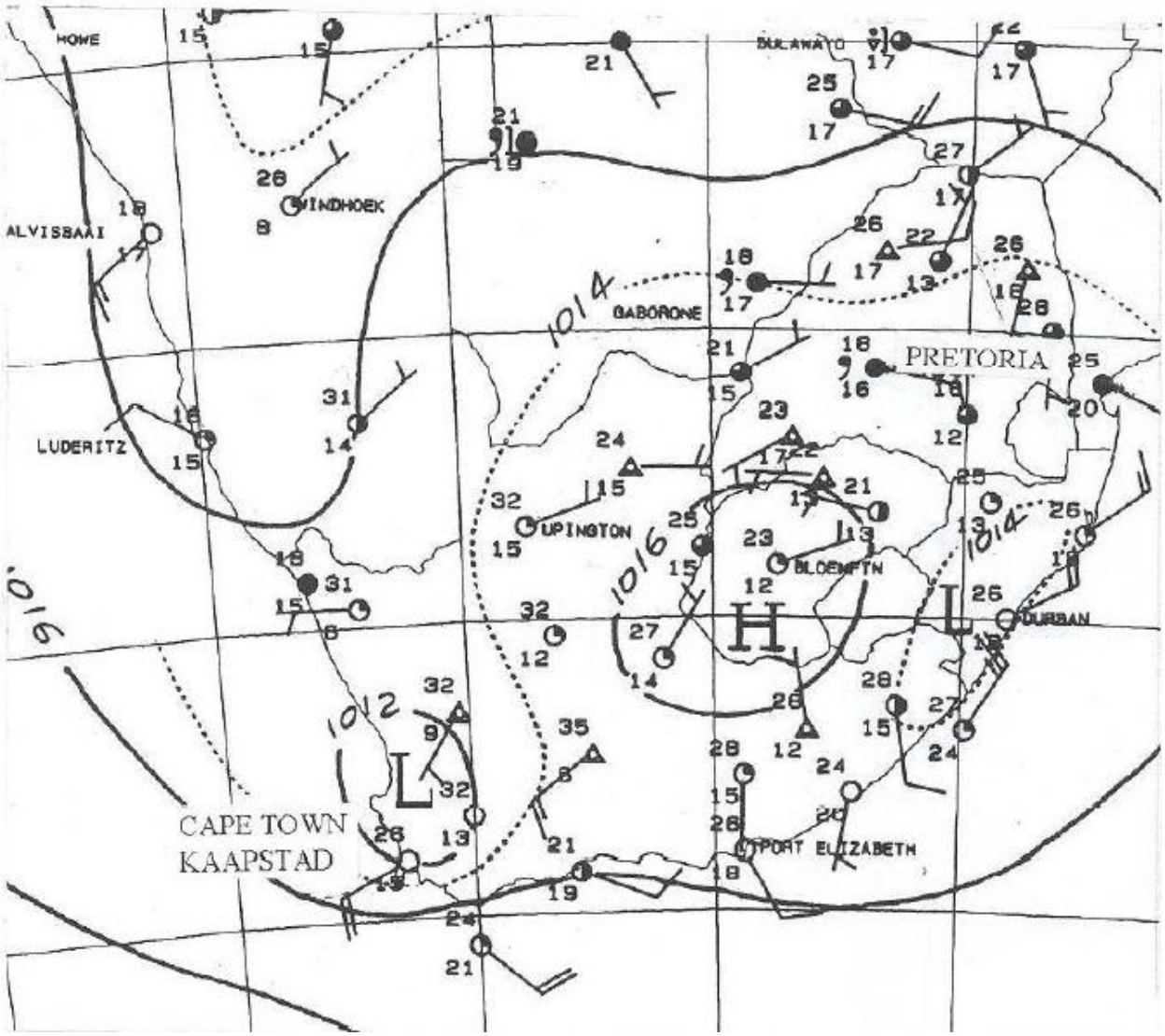
2.1.1 The synoptic chart shows typical (winter/summer) conditions.

2.1.2 The low pressure (L) north of Cape Town is known as a (coastal low/temperate cyclone).

2.1.3 Dew point temperature at Upington is (32 °C/15 °C).

2.1.4 Wind direction at Cape Town is (southwest/northeast).

2.1.5 Pretoria is experiencing (drizzle/rain). (5 x 2) [10]



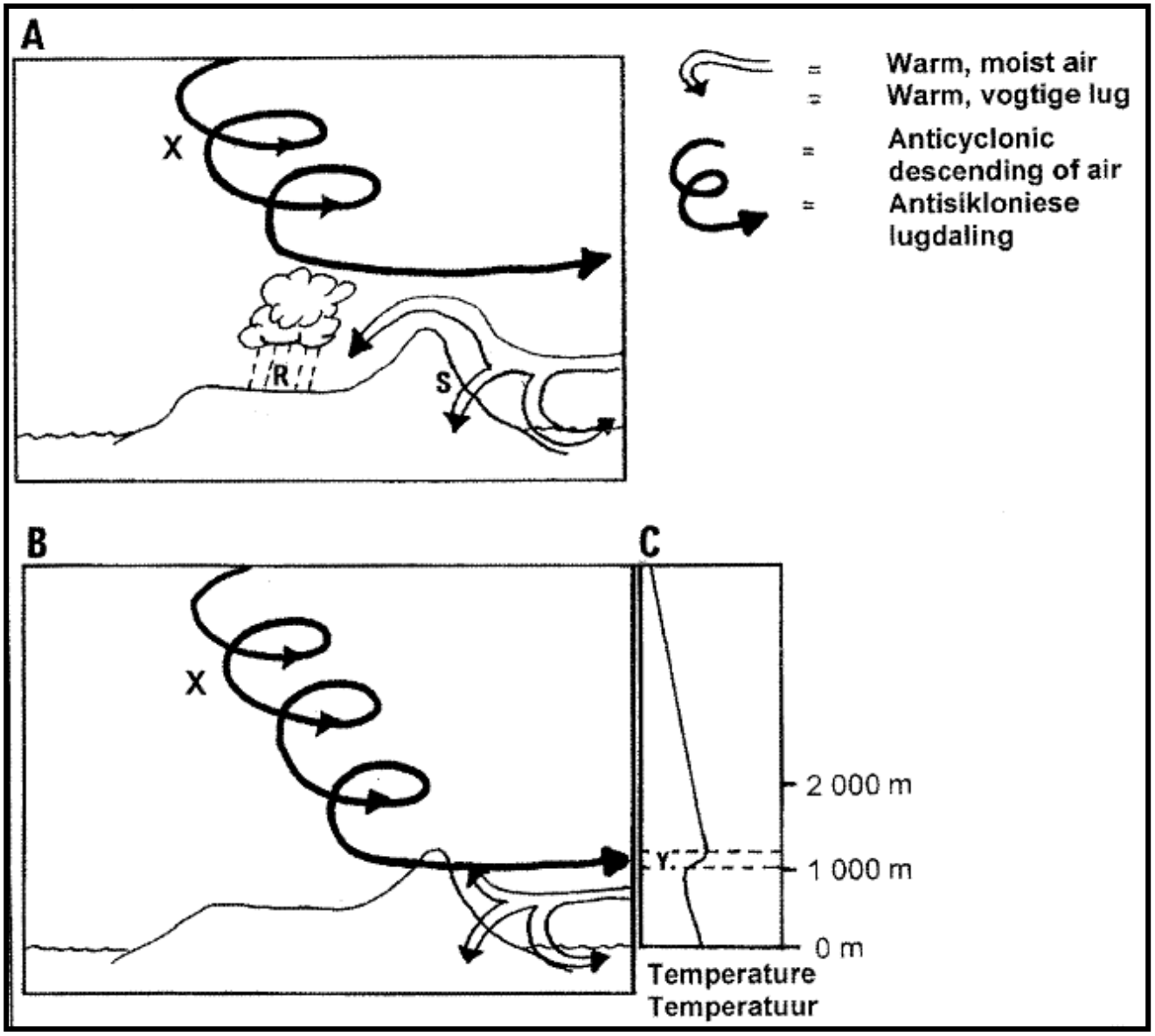
QUESTION 3: 15 minutes 20 marks *(Source: DoE March 2010)*

3.1 FIGURES 3A and 3B show weather conditions that South Africa will experience at different times of the year. Also read the extract on droughts below. If the conditions illustrated in FIGURE 3B persist, South Africa may experience a severe drought.

Hot, dry weather from January to March 2007 wilted crops in southern Africa. The severe drought produced near-record temperatures that, combined with a lack of rainfall, caused extensive crop damage, particularly in western crop areas. In South Africa, the anticipated yield from the corn crop dropped from ten million tons in December to six million tons in April, because farmers couldn't plant in the dry conditions and many of the crops that were planted, wilted in the dry heat. The last South African drought of this magnitude occurred in 1992.

The CSIR said, "The 1982-'83 and 1991-'92 droughts were the most severe meteorological droughts of the 20th century in southern Africa." In the 1991-'92 drought, 70% of the crops failed. It was estimated that half of the population in the affected area was at risk of malnutrition, other related health problems, and even starvation.

FIGURE 3



3.1.1 During which season would South Africa experience the weather conditions represented in A and B respectively? (2 x 2) (4)

3.1.2 Name the weather system labelled X on both diagrams. (1 x 2) (2)

3.1.3 Weather system X is responsible for the development of stable conditions which frequently occur over the South African interior during winter. Briefly explain why weather system X is responsible for the development of stable conditions over the interior. (2 x 2) (4)

3.1.4 In which one of the diagrams, A or B, is the above-mentioned condition clearly visible? (1 x 2) (2)

3.1.5 FIGURE 3C is a graph showing the vertical temperature gradient as experienced in FIGURE 3B.

(a) Describe the temperature changes as shown on the graph in FIGURE 3C. (3 x 2) (6)

(b) What is the zone labelled Y known as? (1 x 2) (2)

[20]

SECTION D: SOLUTIONS AND HINTS TO SECTION A: TOPIC 1

QUESTION 1

1.1.1 Temperature rises with altitude ✓✓ [Concept] (1 x 2) (2)

1.1.2 Kalahari High Pressure ✓✓ (1 x 2) (2)

1.1.3 Descending air heats up ✓✓
Warm layer of air at bottom of Kalahari High Pressure cell ✓✓
Warm air meets cooling air that rises from Earth's surface ✓✓
[Any TWO] (2 x 2) (4)

1.1.4 Inversion lower than the escarpment ✓✓
Warm moist air cannot reach the interior ✓✓
Little moisture over interior will reduce condensation ✓✓
No cloud formation to block out the ✓✓ [Any THREE] (3 x 2) (6)

1.1.5 Higher ✓✓ (1 x 2) (2)

1.1.6 During summer moist air reaches the interior ✓✓
Precipitation over the interior ✓✓
Rivers filled with water ✓✓
Farming can take place ✓✓ [Any TWO] (2 x 2) (4)

[20]

QUESTION 2

2.1.1 (a) X - South Atlantic (St. Helena) HP ✓✓
Y - Kalahari (Continental) HP ✓✓
Z - South Indian (Mauritius) HP ✓✓ (3 x 2) (6)

(b) Y / Kalahari (Continental) HP ✓✓ (1 x 2) (2)

(c) **Differences**

Summer	**Winter**
Moist air	Dry air ✓✓
Cloudy	No clouds ✓✓
Rainfall Little	No rain ✓✓
No frost	Frost at night ✓✓
Small temp range	Large temp range✓✓

[Any ONE difference]

Explanation

Inversion above escarpment in summer and lower in winter ✓✓
Moist air can reach interior in summer not in winter ✓✓
Condensation and cloud cover in summer but limited in winter ✓✓
Increased terrestrial radiation during winter night results in very low temperatures at night ✓✓

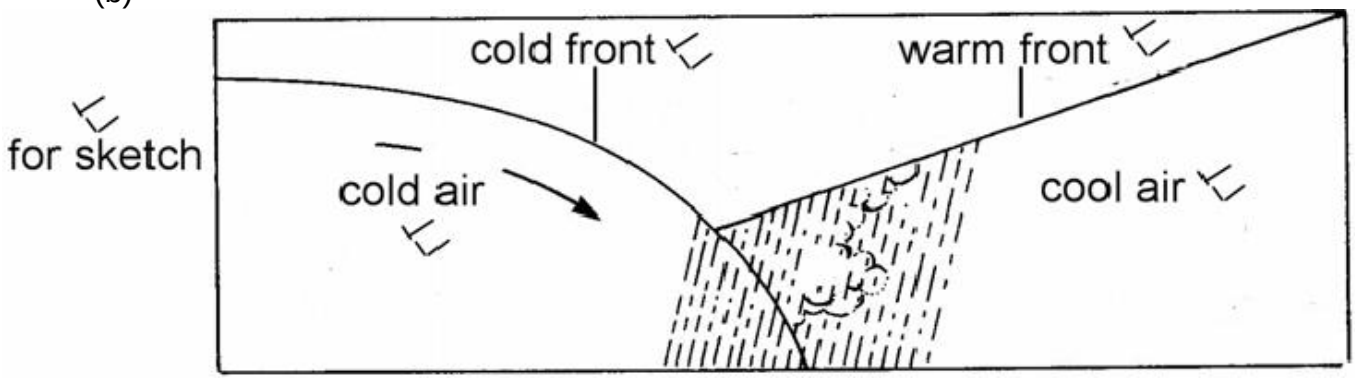
[Any TWO for explanation – must fit reason] (3 x 2) (6)

[14]

QUESTION 3

3.1.1 (a) Mid-latitude Cyclone ✓✓/ Temperate cyclone. ✓✓ (1 x 2) (2)

(b)



[Any TWO labels + ✓✓ for correct sketch] (3 x 2) (6)

3.1.2 (a) B – South Atlantic / St. Helena High Pressure Cell ✓✓
C – South Indian / Mauritius High Pressure System ✓✓ (2 x 2) (4)

(b) B is ridging in south of South Africa and blocking the cold fronts from affecting the Western Cape ✓✓
This will reduce the amount of precipitation, wind, cloud cover and cold conditions over the Western Cape ✓✓ (2 x 2) (4)

3.1.3 (a) Kalahari High Pressure ✓✓/ Continental High Pressure ✓✓ (1 x 2) (2)

(b) During winter the inversion layer associated with the Kalahari high pressure is below the level of the Escarpment, resulting in little or no rainfall ✓✓
During summer the inversion layer associated with the Kalahari high pressure is above the level of the Escarpment, resulting in rainfall ✓✓ (2 x 2) (4)

[22]

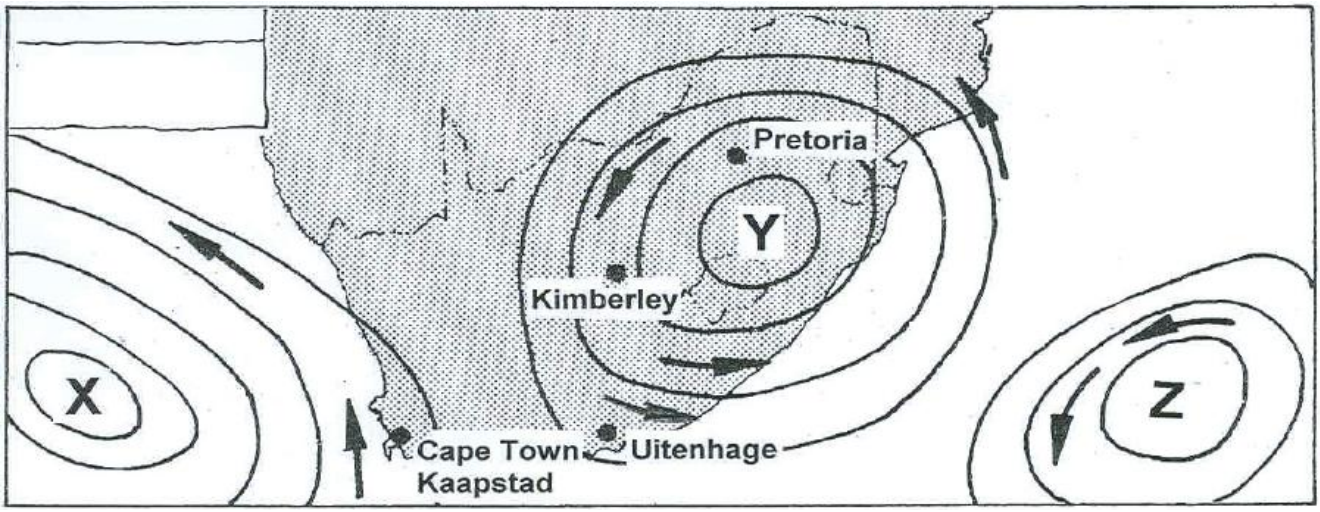
TOPIC 2: TRAVELLING DISTURBANCES

Learner Note:
Traveling disturbances

- Development of
  - o Moisture front and line thunderstorms
  - o Coastal low pressure
  - o South African berg wind
- Resultant weather
- Identification on synoptic charts

SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: **10 minutes** **14 marks** *(Source: DoE November 2008)*



1.1 (a) During which season do berg wind conditions prevail in South Africa? (1 x 2) (2)

(b) Describe the cloud cover and temperature conditions that exist during the occurrence of a berg wind. (2 x 2) (4)

(c) Explain why the weather conditions mentioned in QUESTION 1.1.1.(b) exist during the occurrence of a berg wind. (2 x 2) (4)

(d) Name the environmental hazard (danger) that is associated with the development of berg wind conditions. (1 x 2) (2)

(e) Which weather system is responsible for the termination (ending) of berg wind conditions? (1 x 2) (2)

[14]

HINTS

Hint 1 – The Kalahari HP is only well developed in winter

Hint 2 – If winds blow from the central plateau to the coast it will descend down the Drakensberg and become warm and dry.

QUESTION 2: 10 minutes 16 marks *(Source: DoE March 2009)*

2.1 Refer to the figure below showing the formation of a storm line.

2.1.1 What is meant by the term storm line as mentioned in the statement above? (1 x 2) (2)

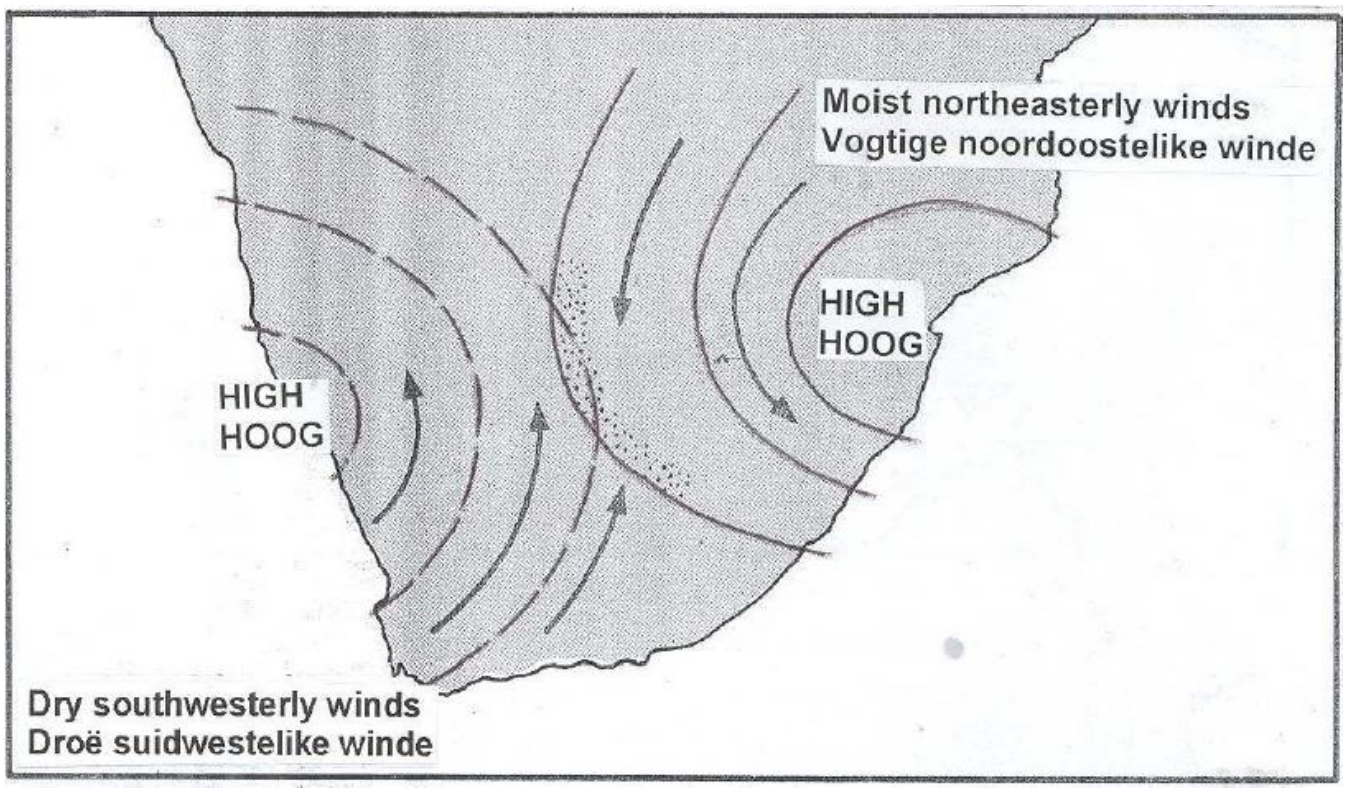
2.1.2 Describe some of the processes (air movement, influx of air) which lead to line thunderstorms occurring. (3 x 2) (6)

2.1.3 What name is given to the band of low pressure that extends across the South African interior along which line thunderstorms develop? (1 x 2) (2)

2.1.4 Do line thunderstorms develop on the eastern or western side of the band of low pressure mentioned in QUESTION 2.1.3? (1 x 2) (2)

2.1.5 Discuss the consequences of line thunderstorms for farming activities in South Africa's interior. (2 x 2) (4)

[16]



HINTS

Hint 1 – Moisture boundary only occur in summer

Hint 2 – Rain forms on the Eastern side of the moisture boundary as the air mass from over the warm Benguela current carries more moisture.

QUESTION 3: 10 minutes 12 marks *(Source: DoE March 2010)*

3.1. FIGURE 3 is a cross-section showing a berg wind that often occurs along the south coast of South Africa. Use your knowledge of berg winds and also refer to FIGURE 3 to answer the questions below.

3.1.1 Identify the type of low pressure, visible in FIGURE 3, which plays a role in the development of berg winds. (1 x 2) (2)

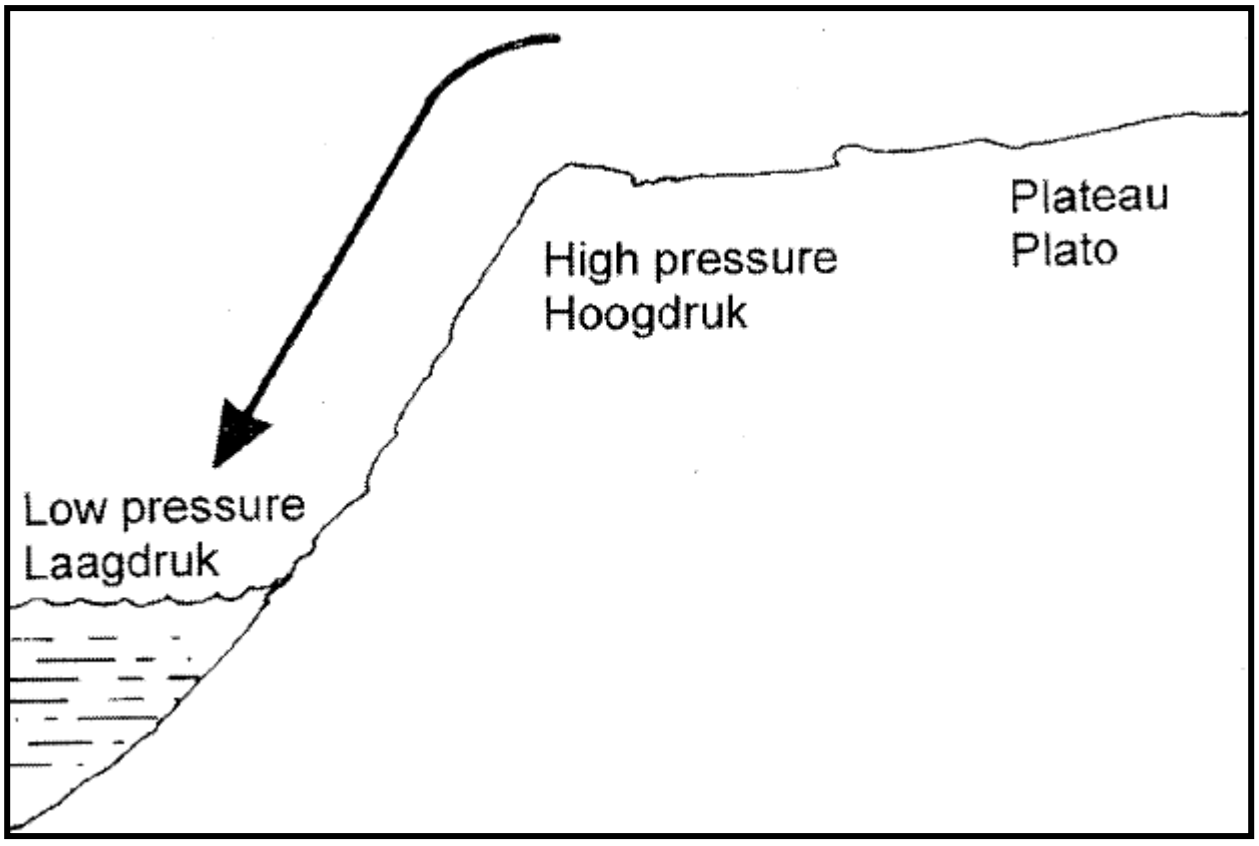
3.1.2 Explain why berg winds will result in warm, dry conditions along the south coast of South Africa. (3 x 2) (6)

3.1.3 Veld fires often accompany berg winds. Give ONE preventative measure that can be introduced to reduce the spreading of veld fires. (1 x 2) (2)

3.1.4 Which weather system is responsible for the dissipation of berg wind conditions? (1 x 2) (2)

[12]

FIGURE 3



QUESTION 4: 10 minutes 22 marks *(Source: Sunday Times 2009 Exemplar)*

4.1. Refer to the Satellite images and simplified map of the same conditions on the next page to answer the following questions:

4.1.1. a) Identify the weather features A and B on the satellite image. (2 x 2) (4)

b) What season was captured on the satellite image? (1 x 2) (2)

c) Explain why feature B is associated with heavy cloud cover. (2 x 2) (4)

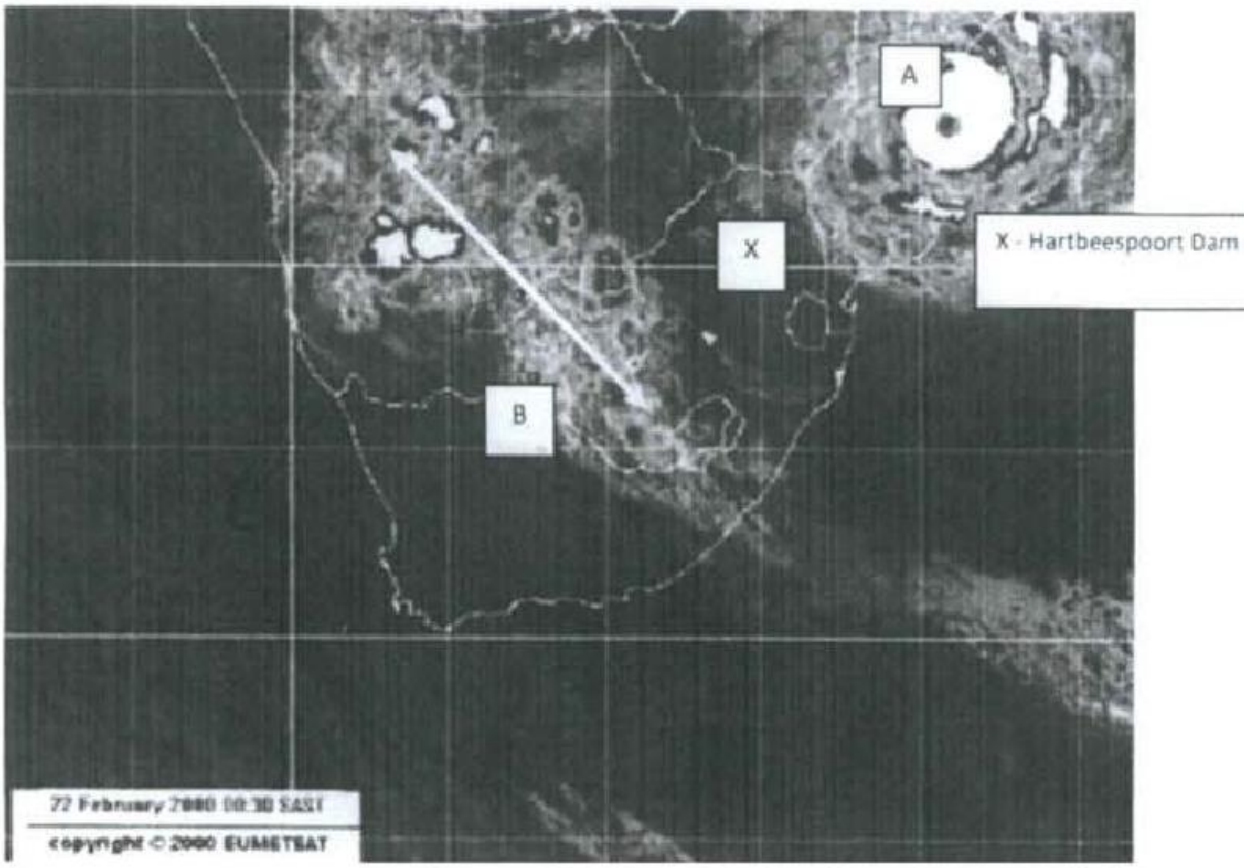
4.1.2 a) Name the high pressure cells at P and Q. (1 x 2) (2)

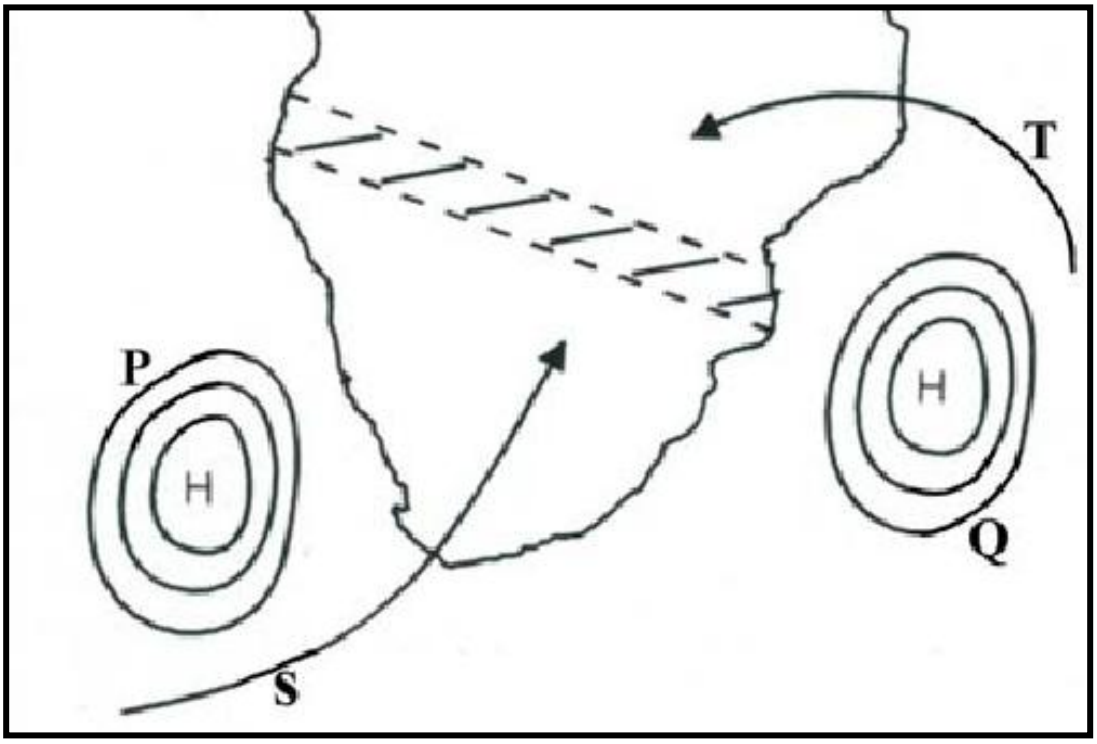
b) Name the winds at S and T and state the characteristics of each. (2 x 2) (4)

c) Compare winds S and T in table form. Refer to temperature, humidity and rain bearing potential. (3 x 2) (6)

[22]

EUMETSAT of South Africa 22 February 2000

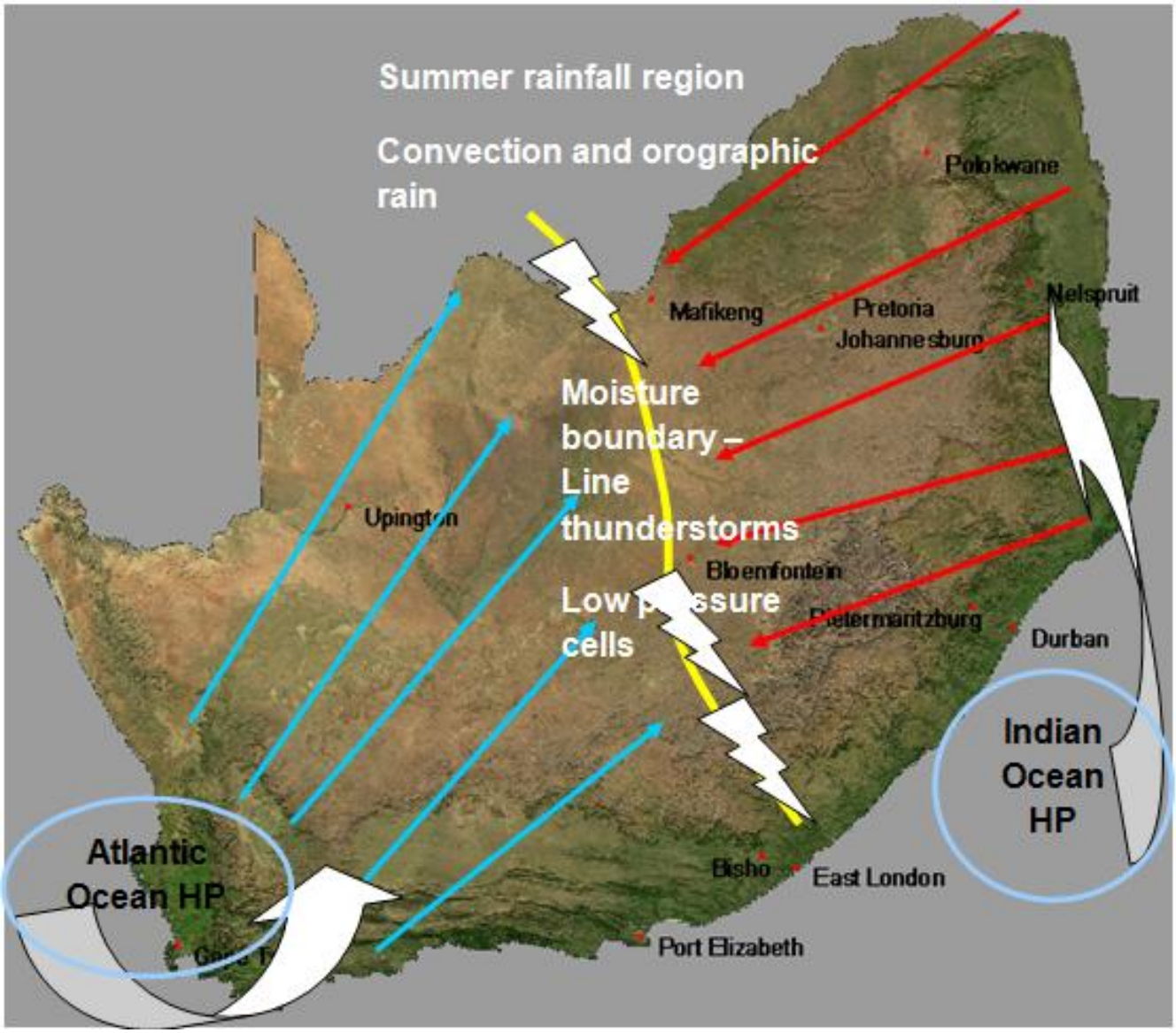




SECTION B: ADDITIONAL CONTENT NOTES

The moisture boundary

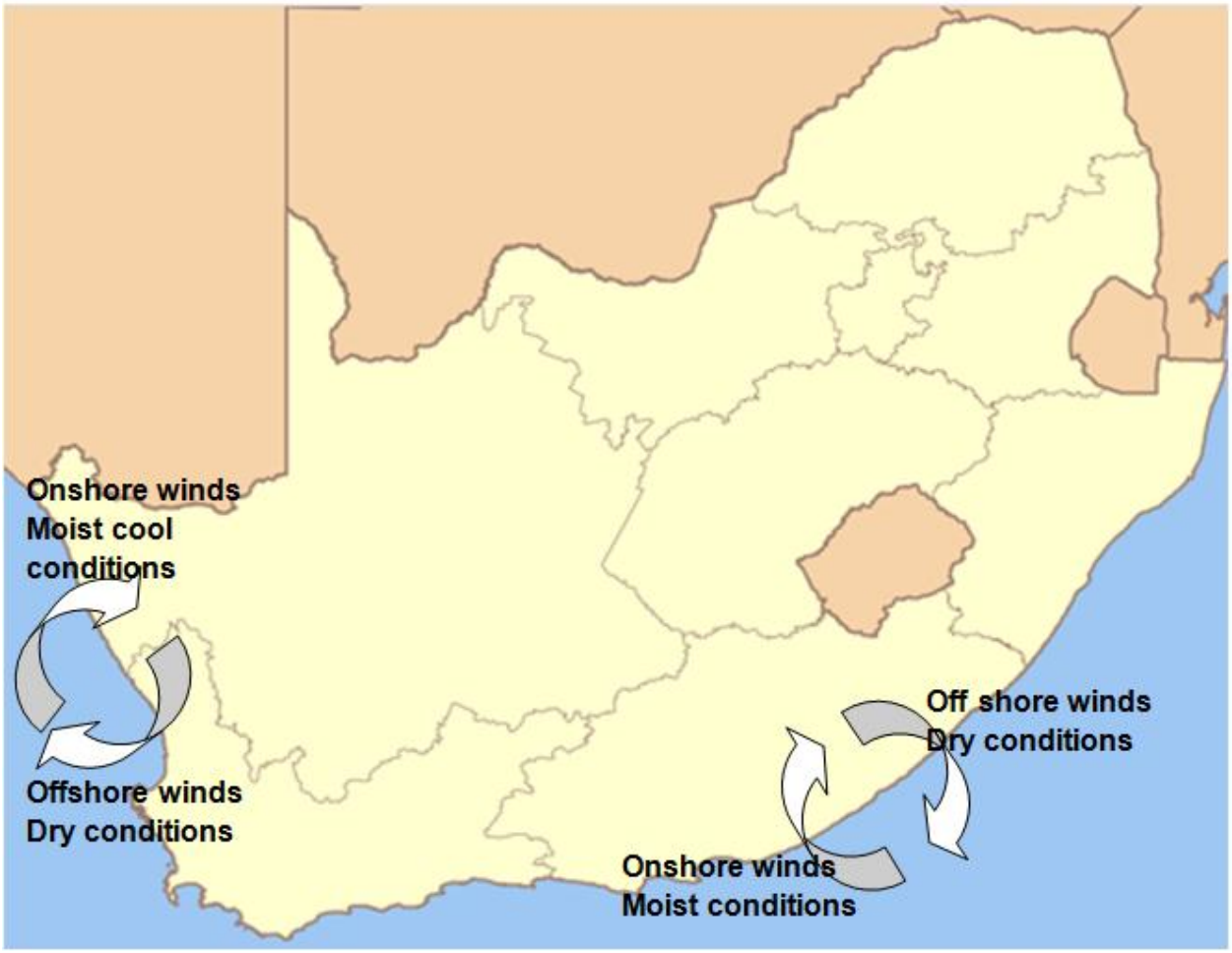
The moisture boundary develop where the cool dry air from the South West pushed into the country from the South Atlantic HP meets the worm moist air coming from the North East (Indian Ocean HP). The cool air lifts the warm air and line thunderstorms develop along this boundary. The moisture boundary develops in summer when the land heats up enough to cause low pressure cells in the interior of the country.



Coastal Low pressure systems

Coastal Low pressure systems develop during summer and winter in SA. These low pressure sytems cause complete different weahter on either side of the pressure cell. The air moves in a clockwise direction around the cell. On the one side of the pressure cell, air will move from the land to the sea and will cause warmer drier conditions. On the other side of the pressure cell where the air mover from the sea to the land, moist cloudy conditions will develop that can lead to rain along the coastline. Along the west coast the air is dry and cool and advection fog often developes rather that rain at the onshore side of the LP.

Coastal Low pressure systems



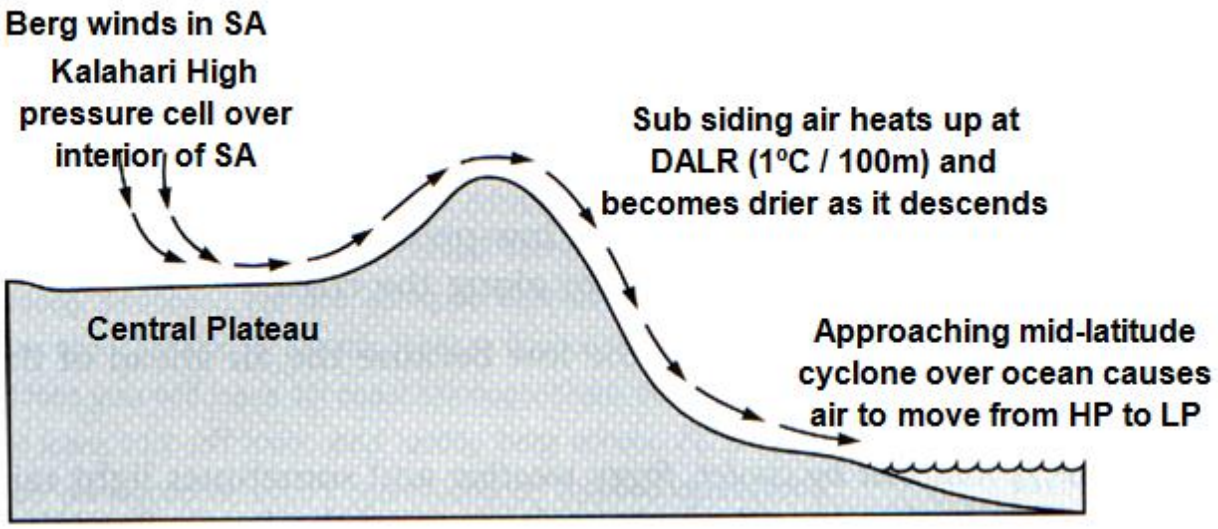
Berg winds In SA

Berg winds in SA develop ahead of a cold front in the warm sector as air descends from the plateau where the Kalahari High Pressure is situated to the low pressure system over the sea. This leads to very hot and uncomfortable conditions along the South Coast, which, shortly after, is then replaced with the cold conditions along the cold front.

Temperature lapse rates

How temperature changes with altitude.

- Environmental lapse rate (ELR) Temperature drops with 0,65ºC/100m in stable air masses.
- When an air mass is moving, the temperature will drop as it rises, or rises as the air subsides with 1ºC/100m. This is called Dry Adiabatic Lapse Rate (DALR).
- When an air mass rises and reachs dew point temperature and condensation takes place, latent heat is released and the temperature only drops with 0,5ºC/100m. This is called Wet Adiabatic Lapse Rate (WALR).



SECTION C: HOMEWORK

QUESTION 1: 10 minutes 20 marks

1. Mid-latitude cyclones develop
   a. in summer
   b. in winter
   c. all year round
   d. in spring and autumn

2. Tropical cyclones develop
   a. in summer
   b. in winter
   c. all year round
   d. in spring and autumn

3. The Kalahari high pressure is best developed i
   a. in summer
   b. in winter
   c. all year round
   d. in spring and autumn
4. The moisture boundary develop over SA
   a. in summer
   b. in winter
   c. all year round
   d. in spring and autumn

5. Orographic and convection rain occur most often in SA
   a. in summer
   b. in winter
   c. all year round
   d. in spring and autumn

6. Frontal rain occur most often in SA
   a. in summer
   b. in winter
   c. all year round
   d. in spring and autumn

7. Hail and thunder storms occur most often over SA in
   a. in summer
   b. in winter
   c. all year round
   d. in spring and autumn

8. Mid-latitude cyclones mostly pass over SA in
   a. in summer
   b. in winter
   c. all year round
   d. in spring and autumn

9. Berg winds occur most often in
   a. in summer
   b. in winter
   c. all year round
   d. in spring and autumn

10. Urban heat islands are more visible in
    a. in summer
    b. in winter
    c. all year round
    d. in spring and autumn (10 x 2) [20]

QUESTION 2: 78 marks

2.1 Refer to MAP 1 to answer the questions

2.1.1. Does this map illustrate summer or winter conditions? (1 x 2) (2)

2.1.2. Motivate you answer in 1.1. (3 x 2) (6)

2.1.3. Identify the weather feature called Celestine in the North Eastern corner of the map. (1 x 2) (2)

2.1.4. Where and under what conditions did Celestine develop? (4 x 2) (8)

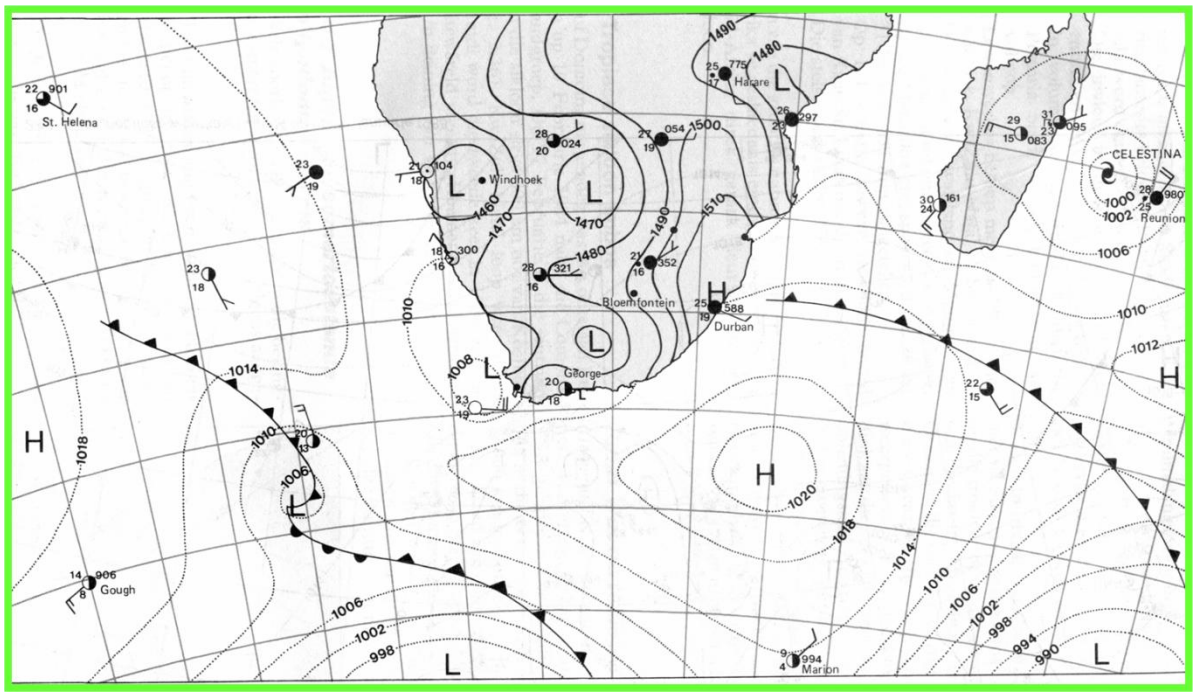
2.1.5. Explain what weather can be expected at Celestine. (3 x 2) (6)

2.1.6. Which parts of SA will be influenced by the weather systems like Celestine? (1 x 2) (2)

2.1.7. When will Celestine dissipate? (3 x 2) (6)

2.1.8. Explain how the rain over the central interior developed**.** (3 x 2) (6)

MAP 1



2.2 Refer to map 2 on the following page o answer the following questions:

2.2.1. Does this map illustrate summer or winter conditions? (1 x 2) (2)

2.2.2. Motivate you answer in 2.1. (3 x 2) (6)

2.2.3. Identify the weather systems South of SA and over SA. (1 x 2) (2)

2.2.4. Describe the weather conditions in Durban. (3 x 2) (6)

2.2.5. Explain why the weather is like what you mentioned in 2.2.5. (3 x 2) (6)

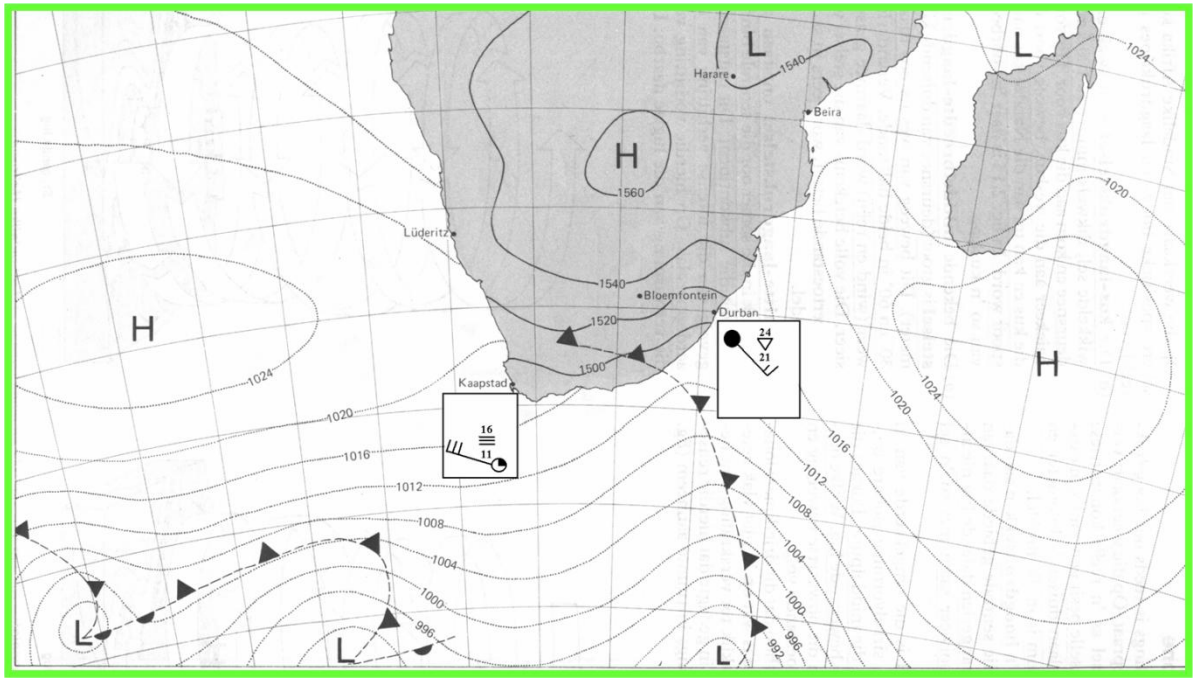
2.2.6. Identify the 3 high pressures on the map. (3 x 2) (6)

2.2.7. Describe the weather over the interior of SA. (3 x 2) (6)

2.2.8. Account for the weather over the interior of SA. (3 x 2) (6)

[78]

MAP 2



SECTION D: SOLUTIONS AND HINTS TO SECTION A TOPIC 2

QUESTION 1

1.1.1 (a) Late autumn / winter ✓✓ (1 x 2) (2)

(b) Clear sky / no clouds / cloud cover 0/8 ✓✓
High temperatures ✓✓ (2 x 2) (4)

(c) Air subsides down escarpment / adiabatic heating ✓✓
Subsiding air heats up ✓✓
Subsiding air does not allow for condensation ✓✓
Subsiding air gets drier ✓✓
[Any TWO] (2 x 2) (4)

(d) Veld fires ✓✓ (1 x 2) (2)

(e) Mid-latitude cyclone ✓✓ (1 x 2) (2)

[14]

QUESTION 2

2.1.1 Band of low pressure over land stretching from NW to SE along which line thunderstorms occur ✓✓
[Concept] (1 x 2) (2)

2.1.2 Cold, dry air moves over the country from SW ✓✓
Warm, moist air moves over the country from NE ✓✓
Cold, dry air meets warm, moist air over interior ✓✓
Warm moist air forced to rise rapidly and very high ✓✓
Large scale cooling and condensation results in thunderstorms ✓✓
[Any THREE] (3 x 2) (6)

2.1.3 Moisture front/Trough line ✓✓ (1 x 2) (2)

2.1.4 Eastern ✓✓ (1 x 2) (2)

2.1.5 Large scale soil erosion ✓✓
Damage to crops ✓✓
Damage to livestock ✓✓
Lightning sets veld on fire ✓✓
Huge economic losses ✓✓
It does bring some water to the interior. ✓✓
[Any TWO] (2 x 2) (4)
[16]

QUESTION 3

3.1.1 Coastal low ✓✓ (1 x 2) (2)

3.1.2 Air descends the plateau ✓✓
Warms adiabatically ✓✓
Subsiding air does not allow for condensation to take place ✓✓
It is dry since it is an offshore wind ✓✓
It decreases atmospheric humidity ✓✓
[Any THREE. Must refer to temperature and humidity] (3 x 2) (6)

3.1.3 Fire breaks ✓✓
Early warning over weather reports ✓✓
[Any ONE] (1 x 2) (2)

3.1.4 Mid-latitude cyclone ✓✓ (1 x 2) (2)
[12]

QUESTION 4

4.1.1. a) A: Tropical cyclone ✓✓
B: Moisture boundary ✓✓ (2 x 2) (4)

b) Summer ✓✓ (1 x 2) (2)

c) Cold dense air lift warm moist air and causes rain ✓✓
Instable air due to high temperatures in summer and large land mass heating the air ✓✓ (2 x 2) (4)

4.1.2. a) P: South Atlantic Ocean High Pressure ✓✓
Q: South Indian Ocean High Pressure ✓✓ (2 x 2) (4)

b) S: South Westerlies ✓✓
T: North Easterlies ✓✓ (2 x 2) (4)

c)

S	**T**	
Cool	Warm ✓✓	
Dry	Moist ✓✓	
Cannot render much rain	Renders a lot of rain ✓✓	(3 x 2) (6)

[16]

TOPIC 3: CLIMATE HAZARDS AND CLIMATE CHANGE (SELF STUDY)

Learner Note: This topic combines work from grade 10, 11 and 12 in an integrated way and your understanding of the work will be tested. Paragraph questions on this topic often occur. Flooding is often asked with fluvial processes which occur in the Geomorphology questions. The focus for this section will be on climate change as these questions are asked on their own in exams and not as an integral part of other topics. Throughout the climate chapter, synoptic weather maps and satellite images are used to present information and to ask questions. It is vital that you are able to read a synoptic weather map. The climate hazards are asked in this part of the work as well as mid-latitude cyclones and tropical cyclones.

SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: 15 minutes 18 marks *(Source: DoE Prelim Paper 2008)*

1. Refer to the extract below and answer the questions that follow:

SOUTH AFRICA'S ENVIRONMENTAL CONDITION IS DETERIORATING DUE TO CLIMATE CHANGE

The Western Cape is expected to be heavily affected by the warming and drying associated with climatic change. This area will experience a significant reduction in rainfall and a 10% reduction in run-off by 2015. The greenhouse effect is a significant contributor to global warming. The greenhouse effect can be reduced by decreasing greenhouse gases through greenbelt development. The Kyoto Protocol, a legal document, was designed to ensure that climate change policies are implemented, such as enhancing of energy efficiency, limiting gas emissions and developing sustainable forms of agriculture. South Africa undersigned the Kyoto Protocol.

1.1. Define the following terms:

(a) Global warming (1 x 2) (2)

(b) Greenhouse effect (1 x 2) (2)

1.2 Name ONE weather change that results from climate change. (1 x 2) (2)

1.3 Name TWO ways in which climatic changes could affect people. (2 x 2) (4)

1.4 Greenbelt development will reduce greenhouse gases. Explain how this process occurs. (2 x 2) (4)

1.5 What is the main reason for implementing the Kyoto Protocol? (1 x 2) (2)

1.6 Give ONE reason for some highly industrialised nations such as the United States of America, not signing the Kyoto Protocol. (1 x 2) (2)

[18]

HINTS
Hint 1 – Make sure you know what the greenhouse effect is – normal temperature control system on earth that allows life on earth – Refer back to gr. 10 work
Hint 2 – Make sure you know what global warming is and how it works and what it implies for humans
Hint 3 – Do not confuse global warming and ozone depletion – they are not the same thing. Ozone depletion does not cause global warming.

QUESTION 2: 5 minutes 10 marks *(Source: DoE March 2009)*

2.1 Refer to the extract from a synoptic weather chart on the following page. Choose the correct term(s) from those given in brackets to make EACH of the statements below TRUE. Write only the term(s) next to the question number (2.1.1 – 2.1.5).

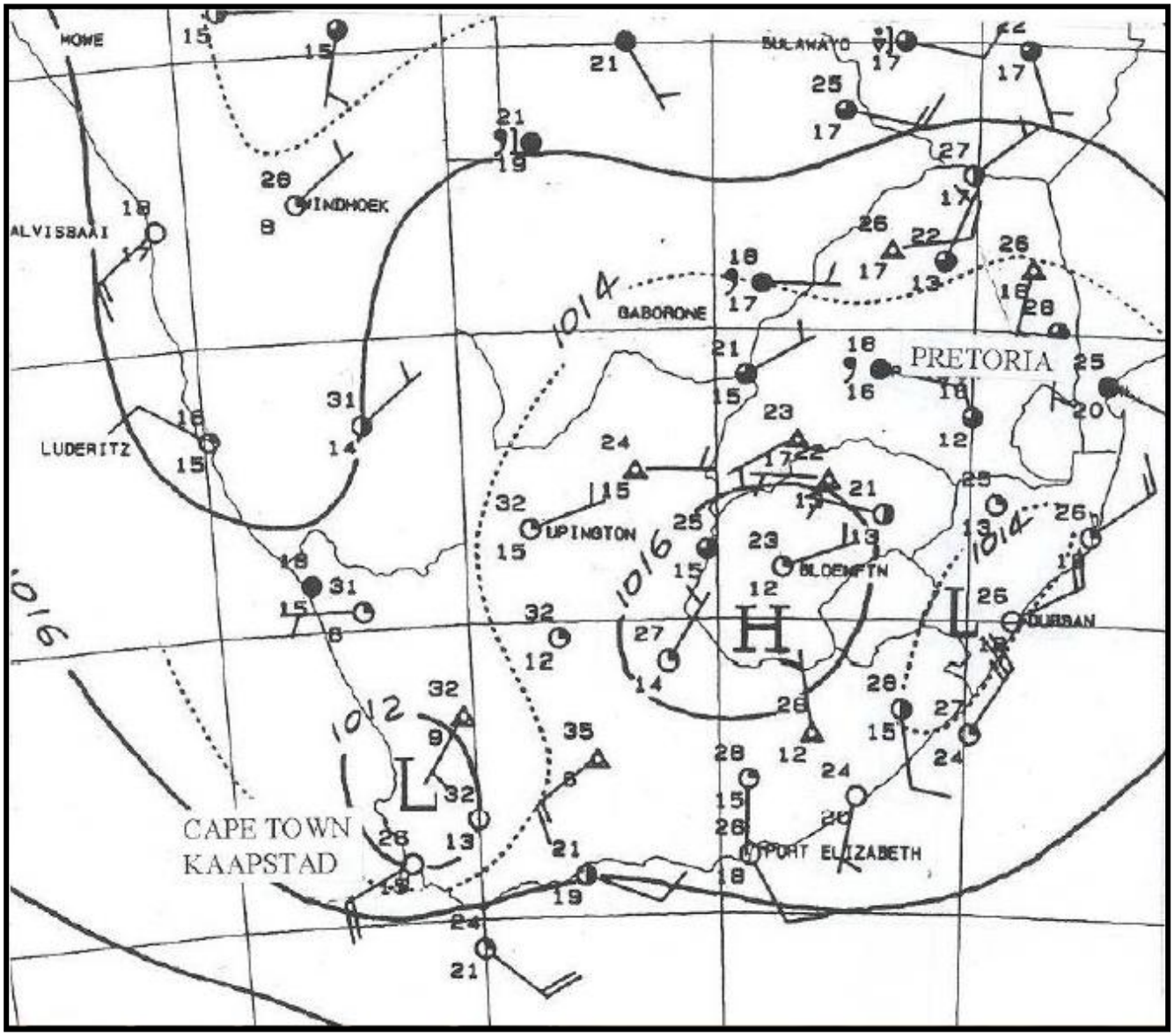
2.1.1 The synoptic chart shows typical (winter/summer) conditions.

2.1.2 The low pressure (L) north of Cape Town is known as a (coastal low/temperate cyclone).

2.1.3 Dew point temperature at Upington is (32 °C/15 °C).

2.1.4 Wind direction at Cape Town is (southwest/northeast).

2.1.5 Pretoria is experiencing (drizzle/rain). (5 x 2) [10]



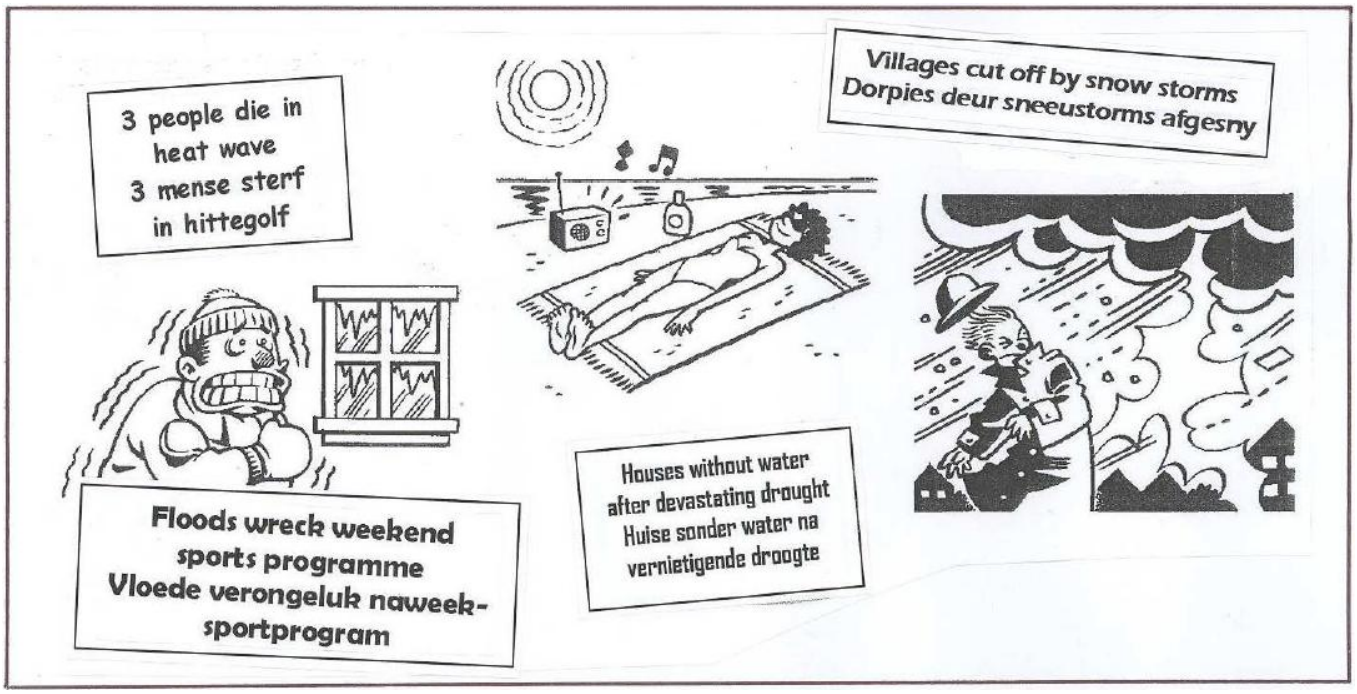
HINTS

Hint 1 – The questions on synoptic weather maps should earn marks easily. Make sure you can read the symbols and information well.

Hint 2 – Temperature and Dew Point Temperature are indicated at each station. The difference between the temperature of the air mass and the dew point, gives you an indication of how humid the air is. The bigger the difference between the two temperatures, the drier the air. IF the temperature and dew point are the same, the air mass is saturated and condensation will take place.

QUESTION 3: 15 minutes 22 marks *(Source: DoE March 2009)*

3.1. The figure below shows some extreme weather conditions that have been experienced lately. Africa's population is the most vulnerable to climatic changes that are taking place. Scientists blame global warming for these extreme weather conditions. Global warming is thought to be the result of the emission of more greenhouse gases into the atmosphere. In order to reduce the emission of greenhouse gases into the atmosphere, many countries signed the Kyoto Protocol in 1997.



3.1.1. What is the meaning of the term global warming? (1 x 2) (2)

3.1.2. Briefly explain why global warming is taking place. (3 x 2) (6)

3.1.3. With reference to the figure above, identify TWO extreme weather conditions that are most likely to be experienced by Africa's population. (2 x 2) (4)

3.1.4 Why do you think the African population is the most vulnerable to climate change? (2 x 2) (4)

3.1.5. In your opinion, do you think the signing of the Kyoto Protocol was successful in reducing global warming? Give reasons for your answer. (3 x 2) (6)

[22]

HINTS

Hint 1 – Do not ignore the sketches; the examiner wants you to refer to those examples in your answers.

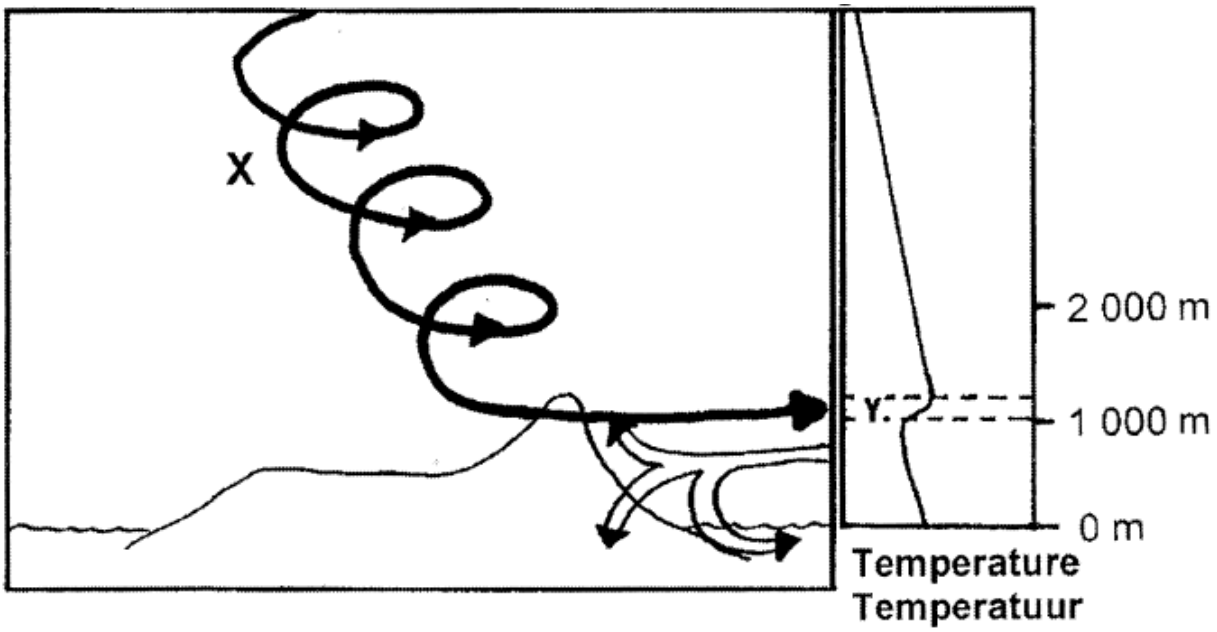
Hint 2 – If you just write a yes / no for a question that you must motivate, you will get no marks. You must motivate your answer to get marks for the yes or no – examiners do not accept a guess.

QUESTION 4: 15 minutes 20 marks *(Source: DoE March 2010)*

4. Droughts often occur in South Africa and can have detrimental effects on the environment and the economy. South Africa will have to put measures in place to ensure that sustainable development is not compromised due to the impact of droughts.

4.1. What is a drought? (1 x 2) (2)

4.2. Explain why the persistence of the condition illustrated in the figure can result in drought over the South African interior. (3 x 2) (6)



4.3. Write a short essay (no longer than 12 lines) in which you discuss measures that can be introduced to reduce the effect of persistent droughts in South Africa. Also give reasons why it is important to reduce the effect of persistent droughts.

(6 x 2) (12)

[20]

HINTS

Hint 1 – Make sure you know the definition of a drought. There is a clear difference between a drought and a desert.

Hint 2 – If the questions ask for a paragraph and you write a list or a bulleted list, you will not get all the marks even if you mention all the answers. Even though the memo is written as a list, you must write it as a paragraph. You need to change the memo answers to sentences that follow on each other.

Hint 3 – Highlight all the key words in the question. Most of the paragraph questions want you to respond to more than one idea. Do not only focus on one part of the question. In Question 4.3 you must discuss **A. measures to reduce the effect of droughts** and **B. Reasons to reduce the effects of droughts.** The marks will be split between these two parts of the question.

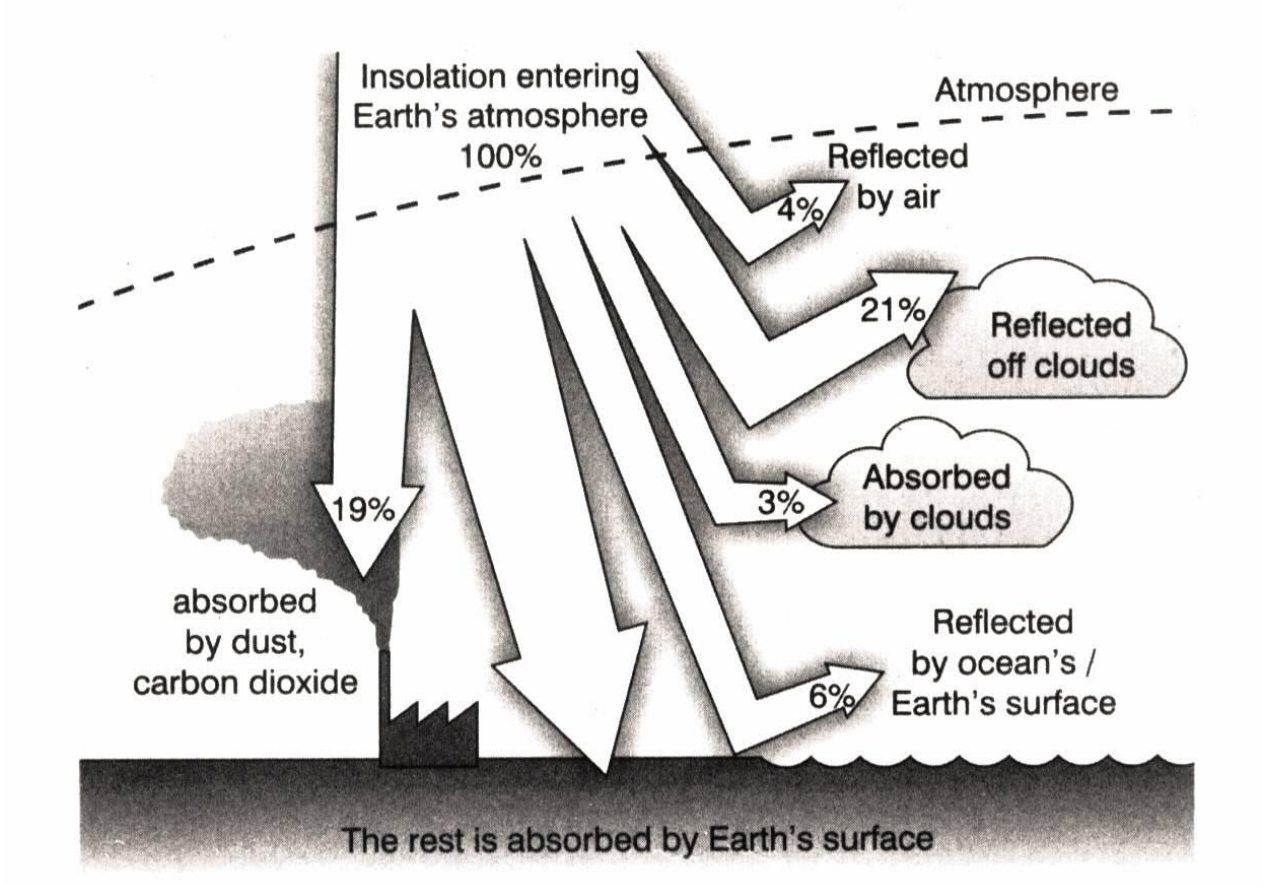
SECTION B: ADDITIONAL CONTENT NOTES

1. GREENHOUSE EFFECT

The greenhouse effect is a natural process which heats the atmosphere and regulates temperature on earth. The greenhouse effect is a necessary process while global warming is a threat to the biosphere on earth.

- Earth's surface is warmed up by the sun's energy in the form of short waves.
- Heat is transferred back into the atmosphere by means of long waves
- The heat energy is slowly emitted back into space and, therefore, heat balance is retained.
- Atmosphere allows short waves of isolation to heat the earth's surface, but absorbs the long waves.
- Heat is, therefore, trapped and kept in the lower layers.
- Gases that absorb and trap the long wave radiation are referred to as GREENHOUSE GASES.
- Water vapor and carbon dioxide are the 2 most important greenhouse gases; there are other pollution gases that also absorb radiation.
- The sun energy can be harnessed by solar panels to produce solar power.

The greenhouse effect heats the atmosphere from the earth upwards



The air pollution causes a strengthened greenhouse effect and that leads to global warming.

2.1. GLOBAL WARMING

Air pollution adds gases to the atmosphere, which absorb heat. The greenhouse effect becomes more effective in trapping heat and this leads to global warming. Pollution releases more greenhouse gases in the atmosphere, which traps more heat. The Kyoto protocol was an agreement between countries to reduce their carbon emissions over a period of time. Many countries signed this contract, but some industrialised countries decided it would be too expensive to implement and it would harm their economies.

- Industrialisation and burning of fossils fuels increases the amount of greenhouse gases
- Deforestation reduces the absorption of carbon dioxide and release of oxygen in the air
- More people and animals cause more respiration and more carbon dioxide
- Increases in herds to produce food, increases methane released into the atmosphere
- Rice production increases methane in air
- Less sulphur dioxide in the air reduces the normal cooling process

2.2. THE CONSEQUENCES OF GLOBAL WARMING

- Sea levels rise due to melting of ice caps
- Extreme weather
    - more tropical cyclones further from Equator
    - monsoons become stronger
- Some animal and plant species become extinct
- Agriculture and water supply adversely influenced
- Bad crop yields cause food shortages
- Increases in diseases like cholera and malaria due to warmer temperatures and more rain

3. **Droughts and floods** are natural hazards that often occur in various parts of the world. There are many reasons why droughts and floods occur, but the frequency of both these phenomena is increasing with changing weather conditions and global warming.
Droughts and floods often occur in cycles in areas that are semi-arid

3.1. WHAT IS A DROUGHT?

- A long period in which an area receives much less than the average amount of rainfall
- The amount of rainfall can vary from area to area to lead to a drought, e.g. if KZN gets 500mm of rain in a year, it is much less than their average of between 800 and 1 000mm, and this will lead to a drought, while the Free State will have normal rain if it gets 500mm of rain in a year.
- Areas that often experience droughts are in danger of desertification
- Drought and the associated famine occur more often in Africa than on any other continent

During continuous droughts, the vegetation deteriorates
Deserts and semi deserts are more susceptible to droughts and desertification

3.2 THE IMPACT OF DROUGHTS

Drought can be devastating to the environment, economy and to humans. Areas that experience droughts must have plans in place to prevent the impact of droughts.

3.2.1. ECOLOGICAL IMPACT

- Lower water table, more evapo-transpiration, less plants
- Poorer soils, saline soils, less plants, more erosion
- More fires
- Biodiversity decreases
- Dry uncovered soil is be eroded by wind

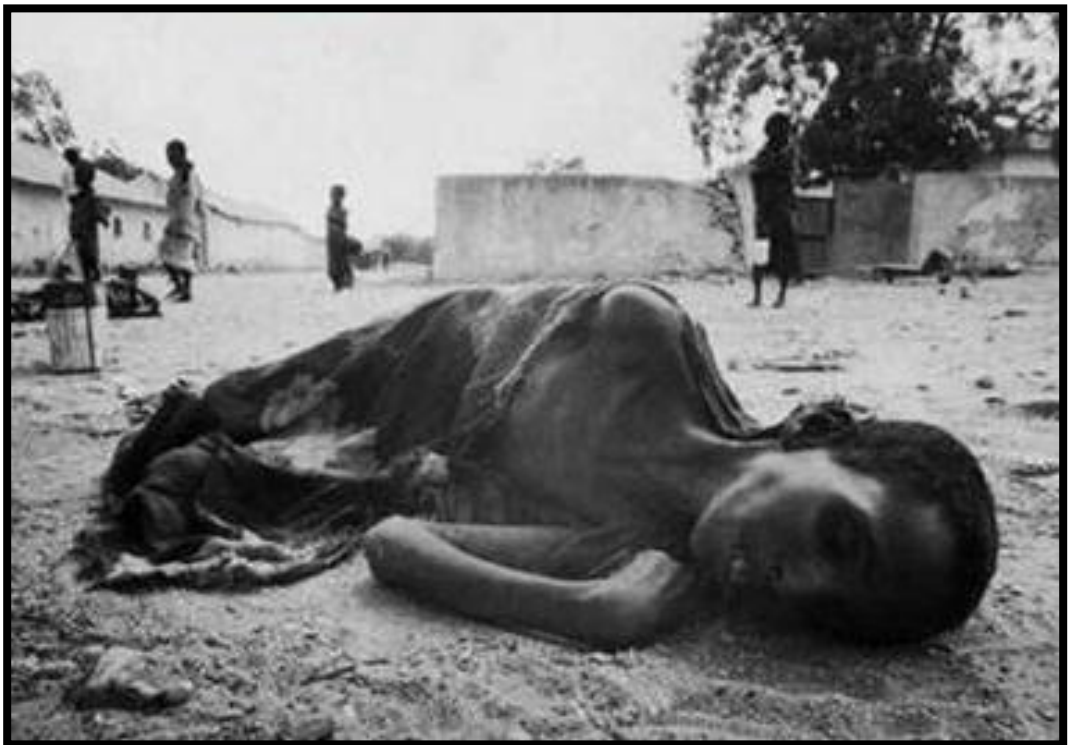
Bush fires destroy natural vegetation

3.2.2. ECONOMIC IMPACT

- Less crops and livestock – higher food prices
- Input costs of farming increases
- Less exports lower GDP (Gross domestic product)
- Food imports
- Industries that rely on farm products suffer
- Job losses – poverty
- Less income from tourism

3.2.3. HUMAN IMPACT

- Unemployment and poverty
- Food shortages, famine and malnutrition
- Rural depopulation and urbanisation
- Water shortages and restrictions
- Africa has problems contributing to the effect of drought:
  - High population growth rates
  - Few farmers
  - Civil wars (Chad, Sudan, Ethiopia) – less farmers
  - Inefficient farming methods



– The severe food shortages during periods of drought lead to famine and loss of life.

3.3. HOW CAN THE IMPACT OF DROUGHTS ON COUNTRIES BE REDUCED?

- Research and monitor of situations that lead to drought to make accurate predictions and warn people.
- Reduce stock before droughts, and only keep a small herd to carry on with after the drought.
- Reduce overstocking which will also reduce the trampling of the veld and associated donga formation when flooding occurs.
- Do not use irrigation in areas that are too dry.
- Water storage dams
- Water schemes to transfer water between different drainage basins to supplement water in drier areas, e.g. the Tugela-Vaal water scheme in SA.
- Water restrictions.

4. WHAT IS DESERTIFICATION?

- When areas become increasingly drier over a period of time.
- This can be attributed to
  - poor farming techniques
  - over utilisation of sensitive semi-dry areas
  - destruction of natural vegetation
  - climatic changes due to global warming
  - Stronger El Nino events

In South Africa desertification is encroaching from the drier west of the country. The semi-arid Karoo and Kalahari areas have been over utilised by farmers with detrimental effects.

5.1. FLOODING

- Heavy rain over a short period of time or
- Gentle rain over longer periods
  - All the water cannot drain away because it falls too fast or the soil is saturated with water.
  - Rivers overflow their banks and areas that are usually dry are covered by water.
  -
- Flooding is aggravated by human activities like:
  - Destruction of natural vegetation, overgrazing, ploughing down slopes, development on wetlands, marshes and swamps
  - People settle on the floodplains of rivers

Flooding damages the infrastructure and causes erosion of the fertile top soil in farming areas.

The river has bursts its banks and covers the whole floodplain.

A photo taken during the flooding caused by cyclone Katrina in the Gulf of Mexico

Flooding cuts people off from the rest of the world and leads to major damage to properties and infrastructure.

Artificial surfaces reduce infiltration and aggravate flooding.

Building on the floodplain and building on steep slopes leads to very bad flood damage – KwaZuluNatal.

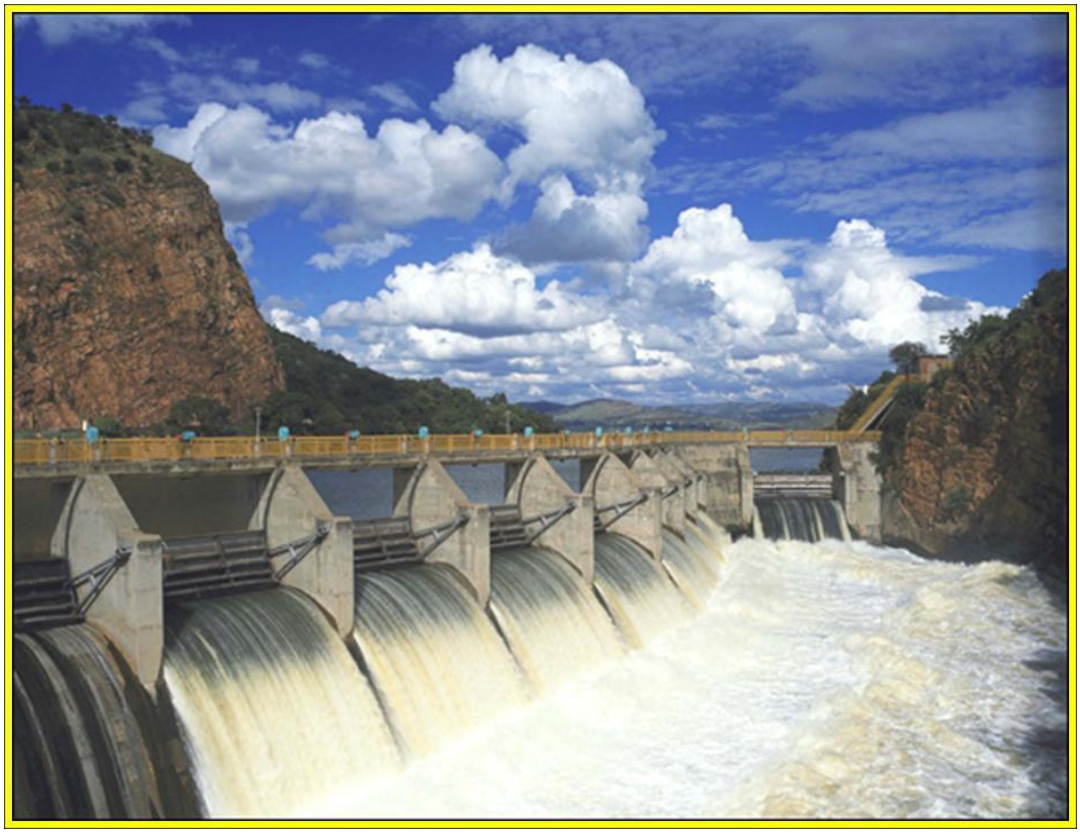
Flooding often claims lives and property in a semi-arid country like South Africa. Most streams are small or even dry up for most of the year. The rich develop riverside properties with a view of the river and the poor erect shacks to get hold of water near to the streams. The same streams become raging torrents and wash away luxury houses and shacks during periods of flooding. People often underestimate the power of floods.

5.2. WHAT CAN BE DONE TO REDUCE THE IMPACT OF FLOODING

- Build dams to regulate the flow of water
- Conserve wetlands as they absorb lots of water and enhance evaporation
- Do not build below the flood lines of rivers
- Build bridges much higher than the normal level of the water to prevent damage during floods
- Do not develop large cities in areas where regular flooding takes place like in tropical cyclone prone areas.
- Conserve the natural vegetation; it enhances infiltration and evapo-transpiration helps to reduce the water levels
- Evacuate areas that are going to be flooded to reduce loss of life
- Have reliable warning system in place to evacuate in time
- Build dyke walls on river banks
- Build canals in cities to regulate the flow river in cities

Dams can conserve water to use during periods of droughts and can regulate flow during flooding. When a dam wall breaks during a flood, it can have catastrophic consequences as all the areas below the dam will be flooded.

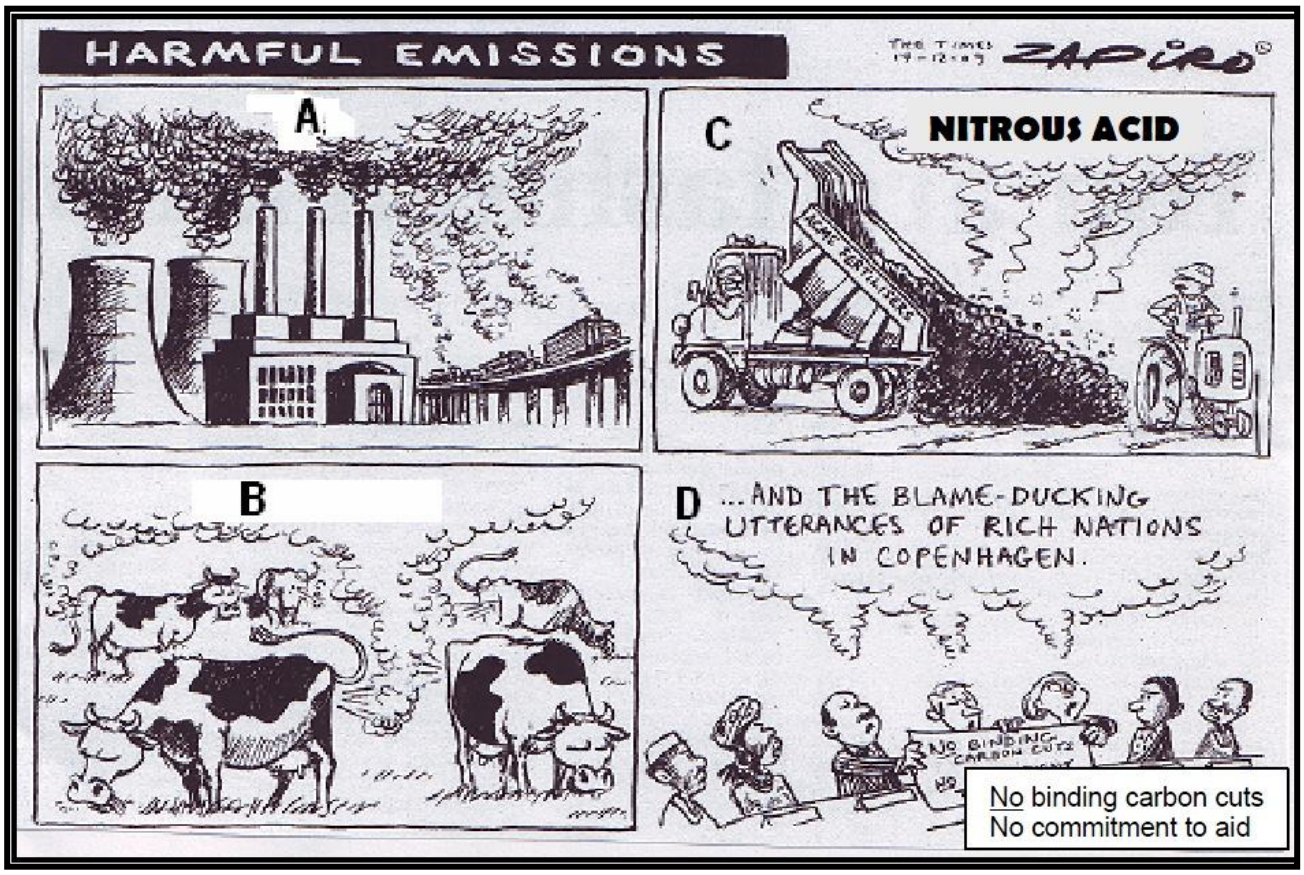
The Hartebeespoort dam in the Crocodile River during a period when water needs to be released through the slues gates.



SECTION C: HOMEWORK: TOPIC 3

QUESTION 1: 30 minutes 24 marks *(Source: DoE November 2010)*

1. Refer to the source material below based on the climate summit held in Copenhagen.



1.1. Name the greenhouse gas being emitted into the urban environment in Cartoon A. (1 x 2) (2)

1.2 Besides industrial activity, explain TWO other factors that contribute to high temperatures in urban environments. (2 x 2) (4)

1.3 Identify the greenhouse gas, associated with farming activities (Cartoon B), which is emitted into the atmosphere. (1 x 2) (2)

1.4. More severe flooding is an indirect result of increased greenhouse gases in the atmosphere. Name TWO negative effects of flooding on farming activities. (2 x 2) (4)

1.5 Environmental groups were not happy with the decisions taken in respect of global warming at the Copenhagen Accord/Summit.
With reference to Cartoon D, write a single paragraph (no longer than 12 lines), discussing possible solutions that delegates from developing countries could have proposed to reduce global warming. (6 x 2) (12)
[24]

SECTION D: SOLUTIONS AND HINTS TO SECTION A: TOPIC 3

QUESTION 1

1. 1 (a) An increase in the average temperature of the earth's atmosphere ✓✓
[Concept] (1 x 2) (2)

(b) Gases, such as carbon dioxide, remain in the upper regions of the atmosphere, trapping heat given off by the earth ✓✓ [Concept] (1 x 2) (2)

1.2 Temperature increases ✓✓
Precipitation decreases/increases ✓✓
Increase in evaporation rate ✓✓ [Any ONE] (1 x 2) (2)

1.3 They would experience more illnesses ✓✓
More floods may occur ✓✓
More droughts may occur ✓✓
Their food supply would be affected – famine ✓✓
Human comfort conditions would be negatively affected ✓✓
Drowning of low-lying coastal areas ✓✓
[Any TWO – accept other logical answers] (2 x 2) (4)

1.4 Trees / plants absorb carbon dioxide during photosynthesis ✓✓
Greenbelt development will increase number of trees / plants that will absorb carbon dioxide ✓✓ (2 x 2) (4)

1.5 To reduce carbon emissions ✓✓
To reduce / slowdown climatic change ✓✓
Trees / Plants will restrict uncontrolled urban expansion ✓✓ (1 x 2) (2)

1.6 • It would impact negatively on the United States of America's industrial growth ✓✓
• United States of America is a highly industrialised country. It, therefore, gives off a lot of pollution contributing significantly to global warming / climatic change. ✓✓
[Any ONE – accept any other logical answer.) (1 x 2) (2)
[18]

QUESTION 2:

2.1.1 summer ✓✓
2.1.2 coastal low ✓✓
2.1.3 15 °C ✓✓
2.1.4 southwest ✓✓
2.1.5 drizzle ✓✓ (5 x 2) **[10]**

QUESTION 3

3.1.1 A general increase in the average temperature of the atmosphere ✓✓

[Concept] (1 x 2) (2)

3.1.2 Industrialisation ✓✓
Higher pollution levels ✓✓
More greenhouse gases emitted into the atmosphere ✓✓
Greenhouse gases absorb more heat ✓✓
Greenhouse gases decrease terrestrial radiation ✓✓
Heat trapped in the atmosphere and temperatures rise ✓✓

[Any THREE] (3 x 2) (6)

3.1.3 Droughts ✓✓
Heat waves ✓✓
Floods ✓✓ [Any TWO] (2 x 2) (4)

3.1.4 Subsistence farmers are dependent on water sources ✓✓
No back up food resources ✓✓
Malnutrition / famine increases as productivity drops ✓✓
More diseases but lack of health facilities ✓✓
Levels of poverty will increase ✓✓
Land deteriorates in drier conditions ✓✓
Landlessness ✓✓
Poor economy cannot sustain large number of unemployed people ✓✓
Do not have capital to absorb losses ✓✓

[Any TWO. Accept other] (2 x 2) (4)

3.1.5 No ✓✓
Large quantities of greenhouse gases still emitted ✓✓
Less developed countries cannot afford less harmful methods to generate energy ✓✓
General rise in temperatures still evident ✓✓
USA not part of Protocol ✓✓
USA has largest percentage of world's industries ✓✓

OR

Yes ✓✓
Coal fired power stations reduced in developing countries ✓✓
Pollution controlled more effectively in developed countries ✓✓
Energy saving appliances used in developed countries ✓✓
Environmentally friendly power sources used in developed countries ✓✓
Using biogas as alternative ✓✓ [Any TWO reasons for answer] (3 x 2) (6)

[22]

QUESTION 4

4.1. A period when rainfall is below average for a region during which vegetation cover decreases ✓✓ [Concept] (1 x 2) (2)

4.2. Kalahari HP remains lower than escarpment ✓✓
This system blocks all moisture from the ocean to reach the interior of the country ✓✓
The Kalahari high is associated with stable air ✓✓
Rainfall will decrease over the interior ✓✓
If the stability of air persists, the interior will experience dry conditions over a period of time ✓✓ [Any THREE] (3 x 2) (6)

4.3. **Preventative measures**

Plant trees to reduce run-off and increase infiltration ✓✓
Eliminate alien trees which use high quantities of water ✓✓
Build dams in areas with low evaporation ✓✓
Contour ploughing to reduce run-off / apply scientific farming techniques ✓✓
Limit irrigation in dry areas / less wasteful irrigation techniques ✓✓
Water transfer schemes to increase water ✓✓
Recycling of water for re-use ✓✓
Conserve underground water supplies ✓✓
Decentralisation of activities away from one major water source ✓✓
Public awareness campaigns on importance of using water sparingly ✓✓

Importance of introducing preventative measures

Droughts reduce yields of crop farmers ✓✓
Reduction in number of livestock ✓✓
Negative implications for exporting ✓✓
Farmers suffer economically ✓✓
Farm workers laid off ✓✓
Fewer raw materials for industries ✓✓
Unemployment rises ✓✓
Balance of trade affected negatively ✓✓

[Accept if learners refer to positive aspects of limiting the effects of droughts]
[Accept other reasonable answers]
[Any SIX. Must refer to preventative measures and importance of introducing preventative measures] (6 x 2) (12)

[20]

TOPIC 1: MAPWORK MULTIPLE-CHOICE QUESTIONS

Learner Note: The mapwork papers consist of 4 different parts namely:

1. Multiple-choice questions - 20 marks
2. Calculations - 20 marks
3. Interpretations of theory on the map – 40 marks
4. GIS – 20 marks

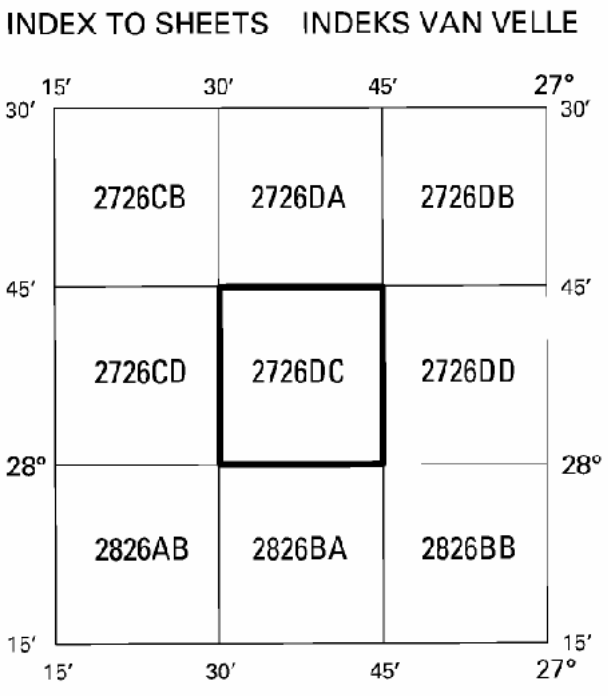
In this topic we will focus on the multiple choice question on mapwork.
The main purpose of the map clips used for this section is to illustrate the map symbols and the relationships between features**. They are not to scale** which means that no distance, gradient, area or speed calculations can be done using the map clips.

SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: 15 minutes 20 marks *(Source: DoE Exemplar 2008)*

The following questions are based on the 1:50 000 topographical map, 2726DC, ODENDAALSRUS as well as the orthophoto map of the same area. Various possible options are provided as answers to the following questions. Choose the answer and write only the letter (A – D) next to each question (1.1 – 1.10).

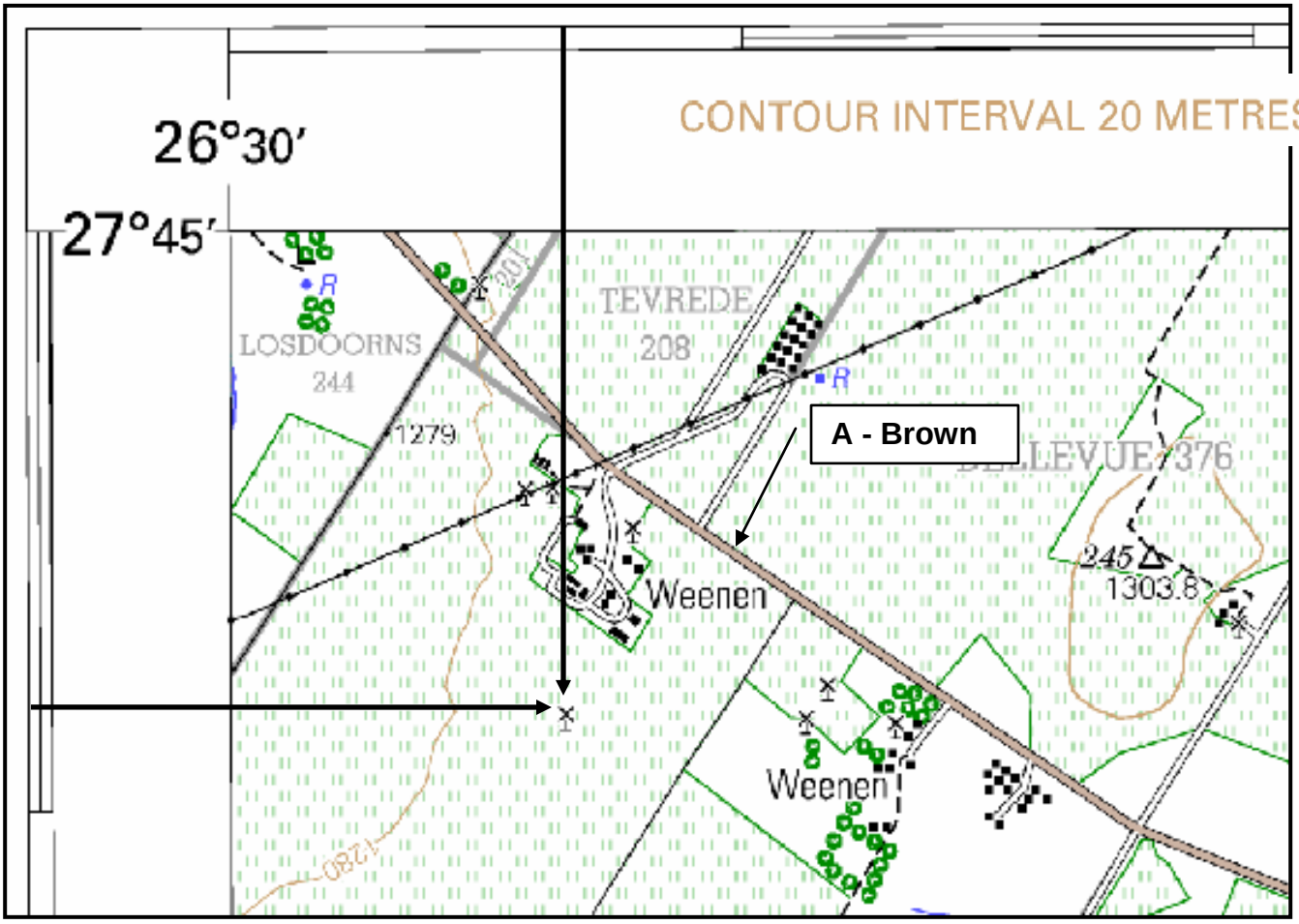
1.1 The number of the map to the west of map 2726DC ODENDAALSRUS is …



(This is printed at the bottom of the map)

A 2726DA
B 2826BA
C 2726DD
D 2726CD

1.2 The exact location (coordinates) of the windmill at the indicate arrows is



A 26°45′09″S 27°45′05″E
B 27°45′50″S 26°30′40″E
C 26°30′05″S 27°45′10″E
D 27°45′10″S 26°30′50″E

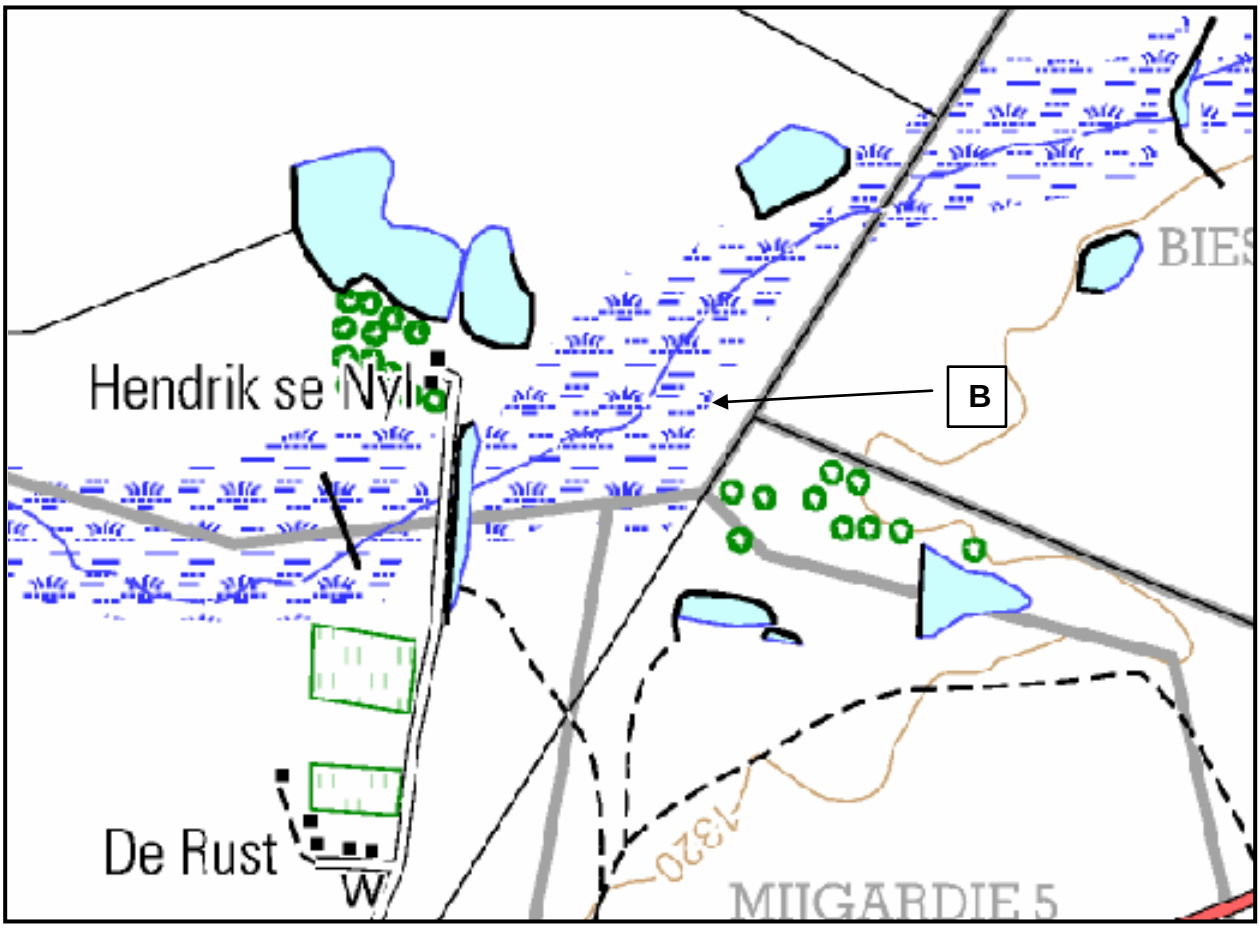
1.3 The direction of spot height 1279 from ▲245…
A South-west
B West North West
C South-east
D East South East

1.4 The man-made feature labelled A on the topographical map is a/an …
A main road
B arterial route
C secondary road
D national road

1.5 The contour interval of the topographical map is …

A 5 m
B 20 m
C 10 m
D 25 m

1.6 The natural feature marked B on the topographical map is a …



A dry pan
B perennial river
C non-perennial river
D marsh and vlei

1.7 The map projection used on the orthophoto map is …
(The following is printed at the bottom of the map)

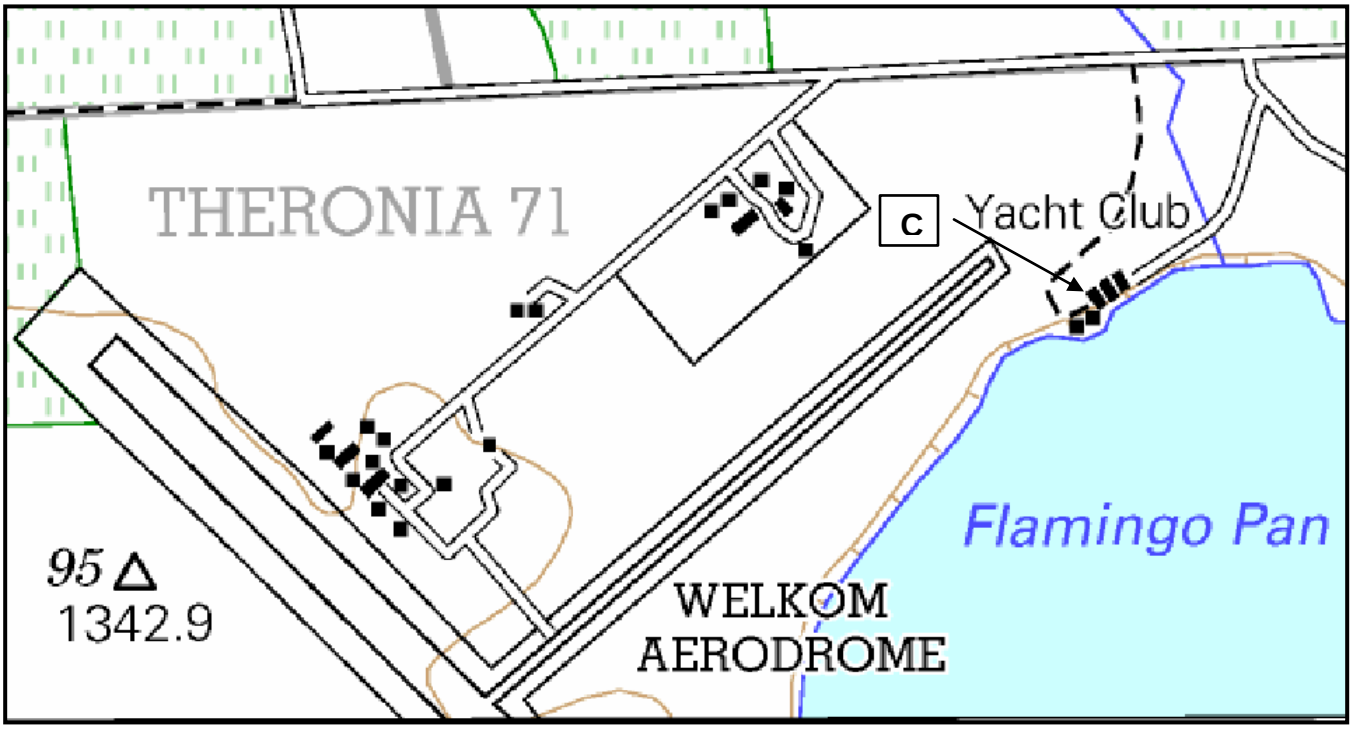
Gauss Conform Projection. Central Meridian 27° East.
Hartebeesthoek 94 Datum (WGS84 Ellipsoid).

A Mercator
B Lambert
C Gauss conform
D universal transverse

1.8 The orthophoto map with a scale of 1:10 000 depicts … part of the topographical map.

A 1/5 of the map
B ½ of the map
C ¼ of the map
D 1/25 of the map

1.9 Aeroplanes can land in a …. direction at the Welkom Aerodrome



A Northerly
B Southerly
C North Westerly
D Easterly

1.10 The area marked C map is (a) …

A mining area
B non-perennial water
C mine dump
D recreational area

(2 x 10) [20]

HINTS

Hint 1 - Write a capital letter as an answer to make sure the markers know exactly what your intended answer was.

Hint 2 - Be sure always to answer this carefully, and do not leave out questions.

QUESTION 2: 15 minutes 20 marks *(Source: DoE November 2008)*

The following questions are based on the 1:50 000 topographical map, 3227DD, CAMBRIDGE, as well as the orthophoto map of a part of the same area. Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A – D) next to each

2.1. The topographical map reference number represents …

A 32°N27°W
B 32°S27°E
C 32°W27°N
D 32°E27°S

2.2. The scale of the topographical map (1:50 000) is … than that of the orthophoto map (1:10 000).

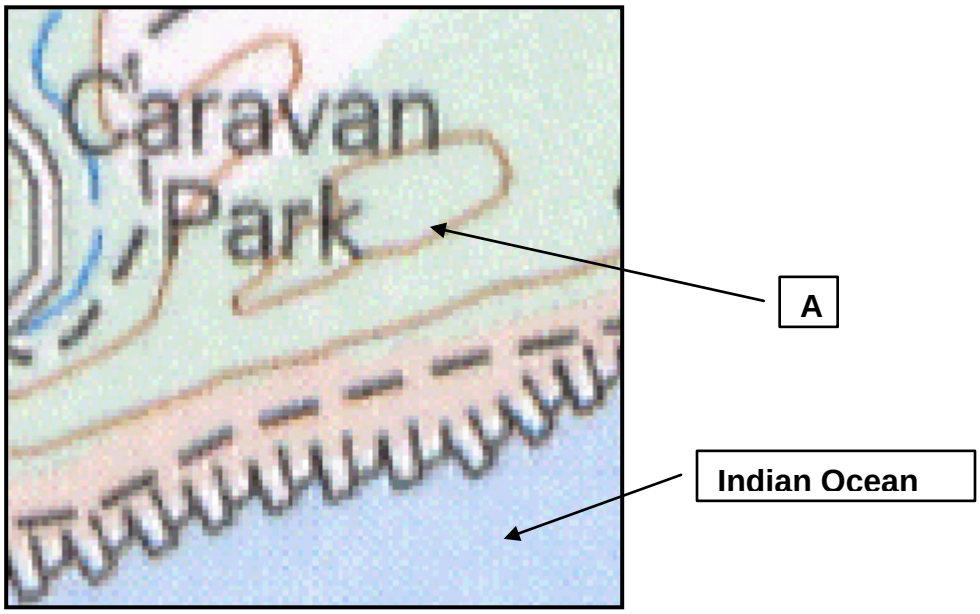
A 5 times smaller
B 5 times larger
C 40 times smaller
D 40 times larger

2.3. The contour interval of the orthophoto map is …

A 5 m
B 20 m
C 10 m
D 25 m

2.4 The coastline in block J7 on the topographical map is mainly ...

A smooth
B dry
C rocky
D sandy



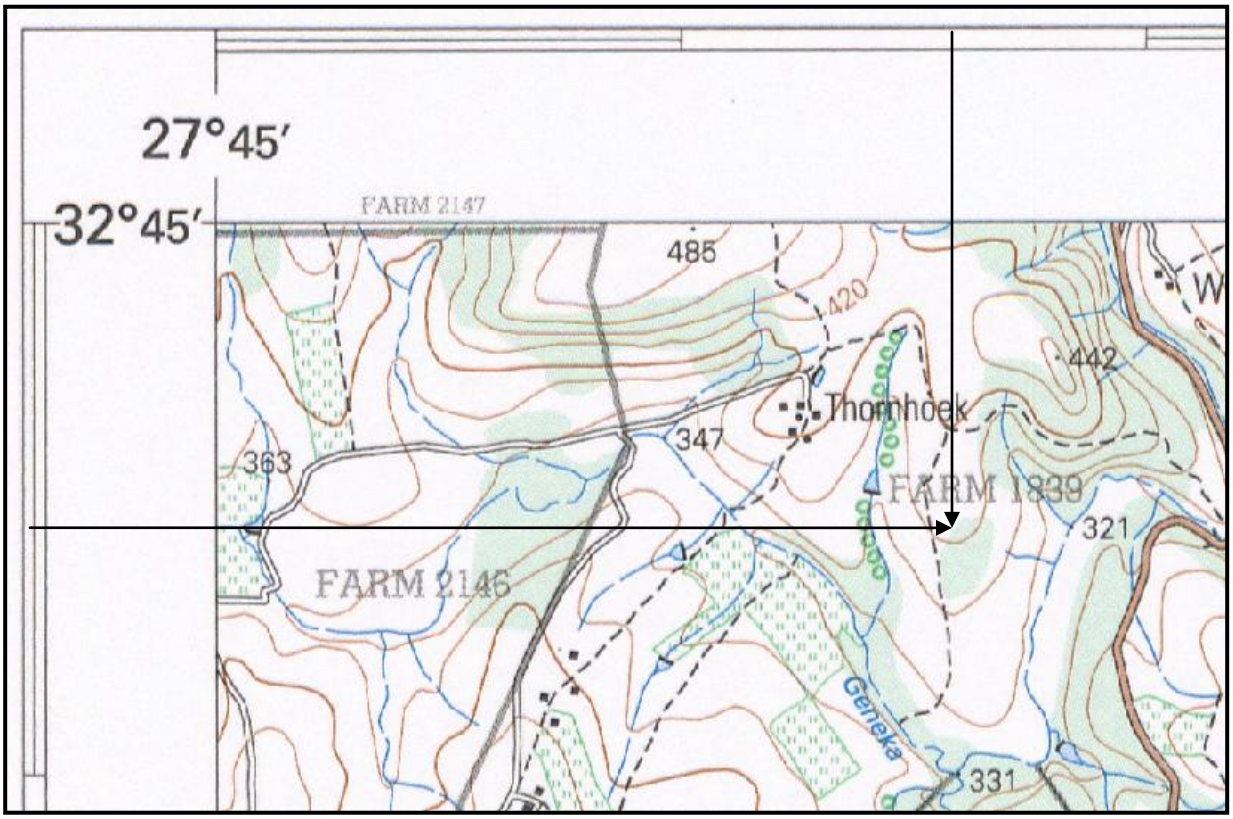
2.5 The altitude of the contour line labelled A is ….

A 0m
B 20m
C 40m
D 60m

2.6 The caravan park will experince … winds during the night

A Sea breezes
B Katabatic winds
C Anabatic winds
D Land breezes

2.7 The location (coordinates) of the farm dam is ...



A 27°45'13"E 32°45'8"S / 27°45,2'E 32°45,2'S
B 32°45'29"S 27°46'23"E / 32°45,5'S 27°46,4'E
C 32°45'8"E 27°46'13"S / 32°45,2'E 27°46,2'S
D 27°46'13"S 32°45'8"E / 27°46,2'S 32°45,2'E

2.8 The direction of flow of the tributary of the Geneka river in 2.7 is
A West
B South
C East
D North

2.9 The function of the dam in 2.7 is …. (Which one does not fit?)
A Recreation
B Store water
C regulate flooding
D supply Cambridge with water

2.10 The highest altitude on the map clip in 2.7 is….
A 347
B 485
C 442
D 521

(2 x 10) [20]

QUESTION 3 20 minutes 20 marks *(Source: DoE November 2010)*

The questions below are based on the 1:50 000 topographical map 3424BB HUMANSDORP, 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 answer and write only the letter (A – D)

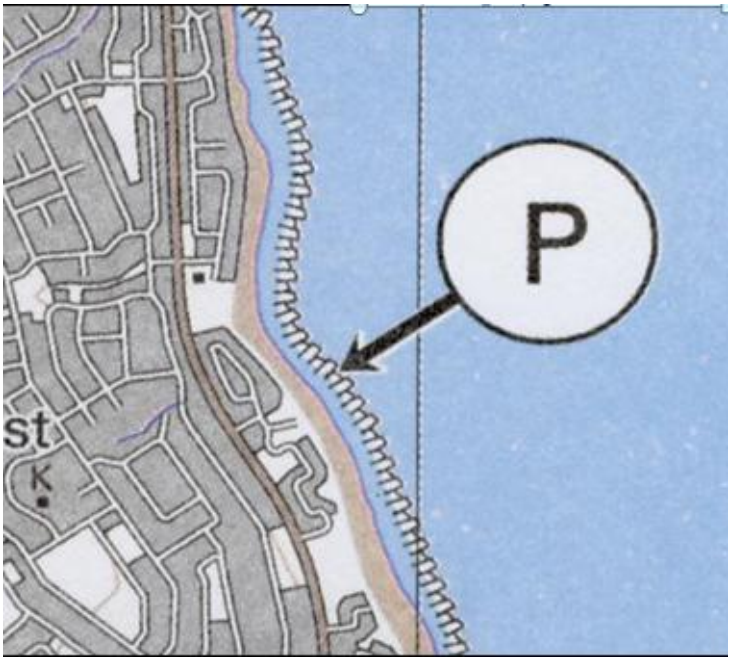
3.1 The earth's curved surface is represented on the topographical map through the … projection.

A Mercator
B Gauss Conform
C Lambert
D Transversal

Gauss Conform Projection. Central Meridian 25° East.
Hartebeesthoek 94 Datum (WGS84 Ellipsoid).

3.2 The landform that is found at P in block B11, is a …

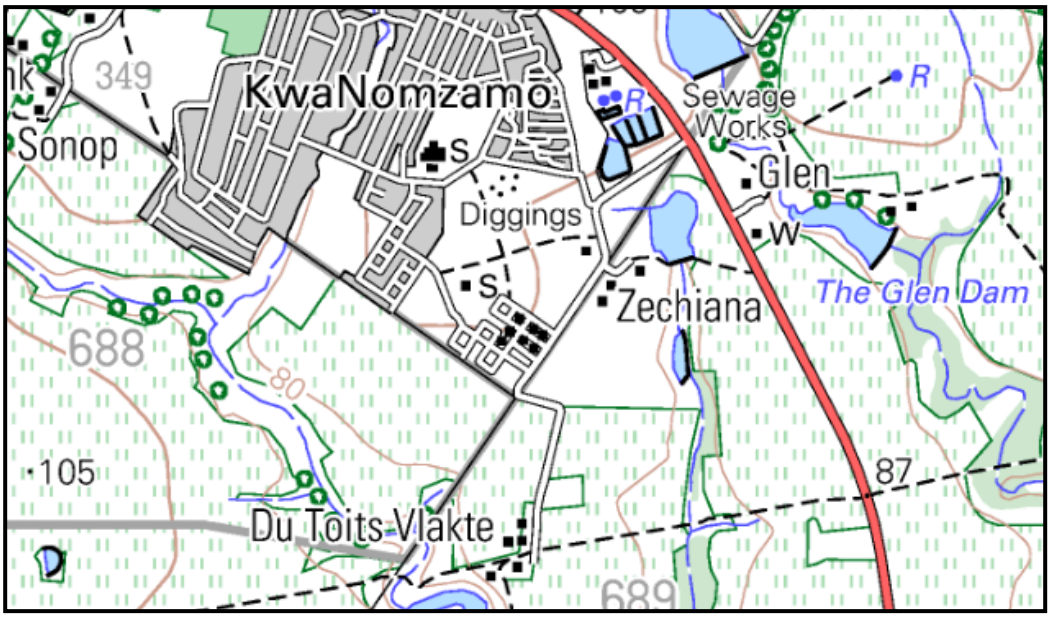
A rocky outcrop
B cape
C sandy beach
D coastal rock



3.3 Ashton Bay has a/an … street pattern.

A grid iron
B radial/cobweb
C planned irregular/free
D unplanned irregular

3.4. The slope south of Kwa Nomzamo (C2) is …



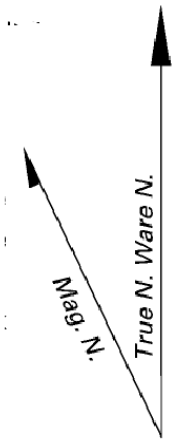
A gentle
B steep
C convex
D concave

3.5 An aerial photograph which shows contour lines, spot heights, trigonometrical stations and other labelled features, is called a/an …

A oblique aerial photograph
B topographical map
C orthophoto map
D vertical aerial photograph

3.6 The mean magnetic declination of this map in 2011 was … (See next pages for info.)

A 26°59′ east of true north
B 26°59′ west of true north
C 23°59′ west of true north
D 23°59′ east of true north

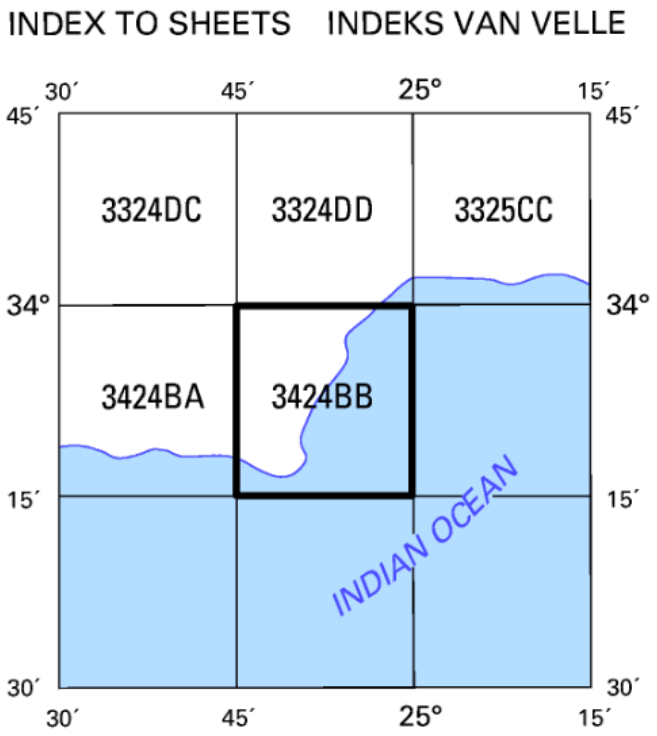


Mean magnetic declination 25°29′ West of True North(July 2001).
Mean annual change 9′ Westwards(1995–2000).
Supplied by Hermanus Magnetic Observatory.

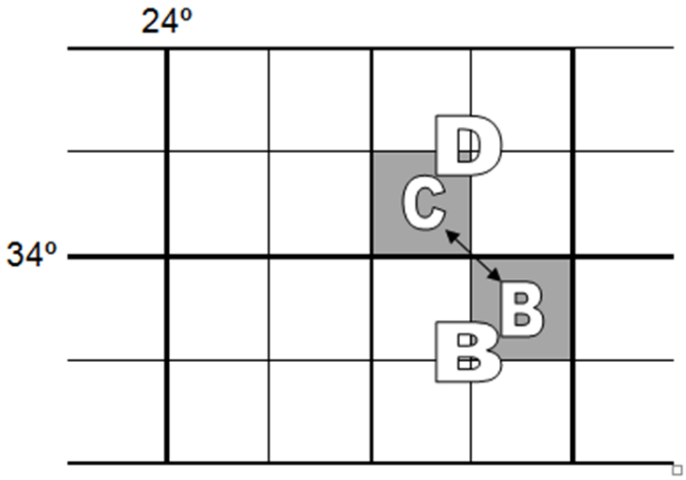
Gemiddelde magnetiese deklinasie 25°29′ Wes van Ware Noord(Julie 2001).
Gemiddelde jaarlikse verandering 9′ Weswaarts(1995–2000).
Voorsien deur die Hermanus Magnetiese Observatorium.

3.7 The index of the map sheet northwest of Humansdorp is …

A 3324DC
B 3324DD
C 3325CC
D 3424BA



Use any one of the explanation



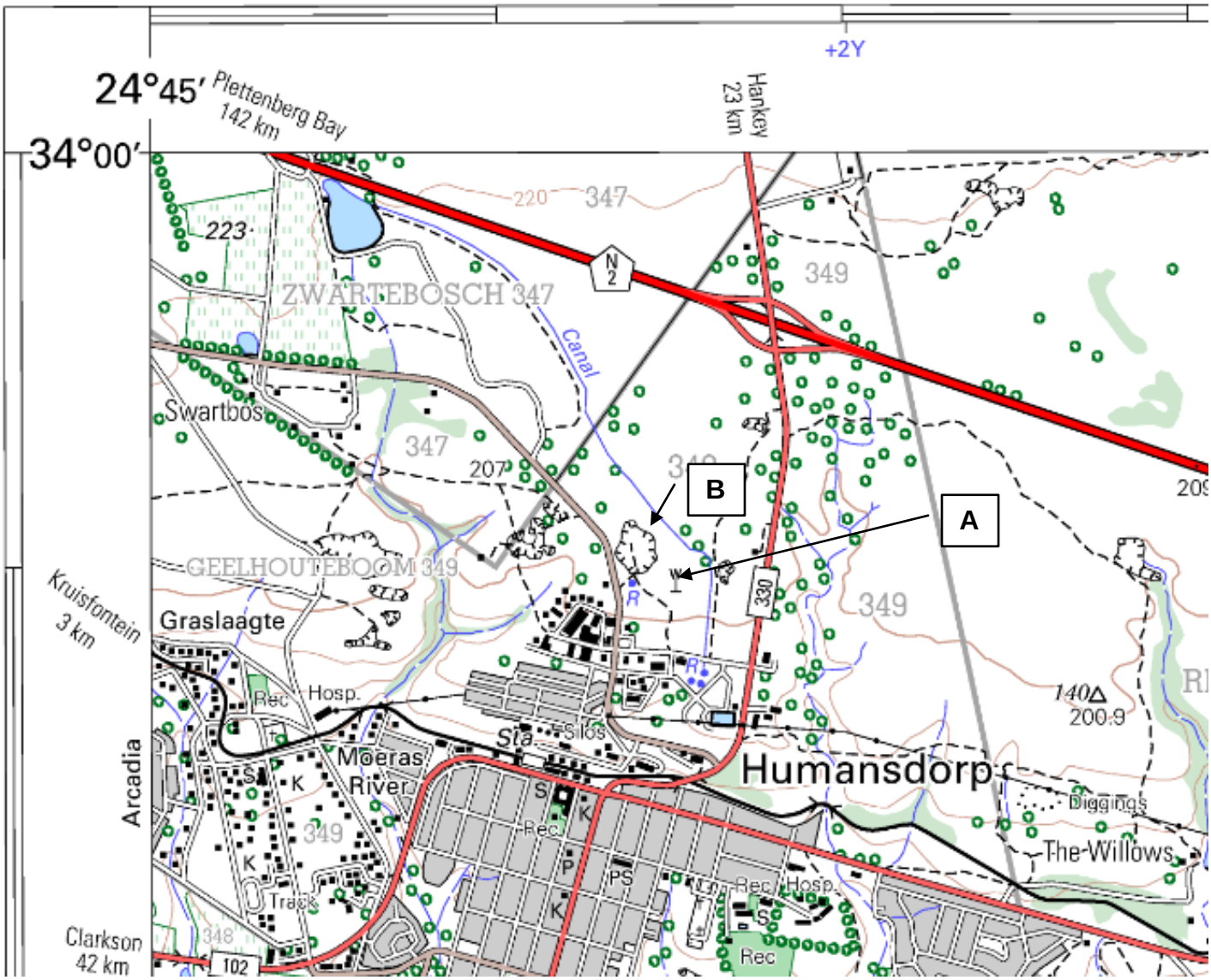
3.8 The co-ordinates of trigonometrical station 140 in block B3 are …

A 34°01′20″S24°47′44″E / 34°01,3′S24°47,7′E

B 34°02′40″S24°48′16″E / 34°02,7′S24°48,3′E

C 34°01′20″E24°47′44″S / 34°01,3′E24°47,7′S

D 34°02′40″E24°48′16″S / 34°02,7′E24°48,3′S



3.9 The feature numbered A on the map is a …

A Wind pump
B Monument
C Communication Tower
D Grave site

3.10 The feature labelled B on the map is a

A Excavation
B Mine dump
C Donga
D Dam

(10 x 2) [20]

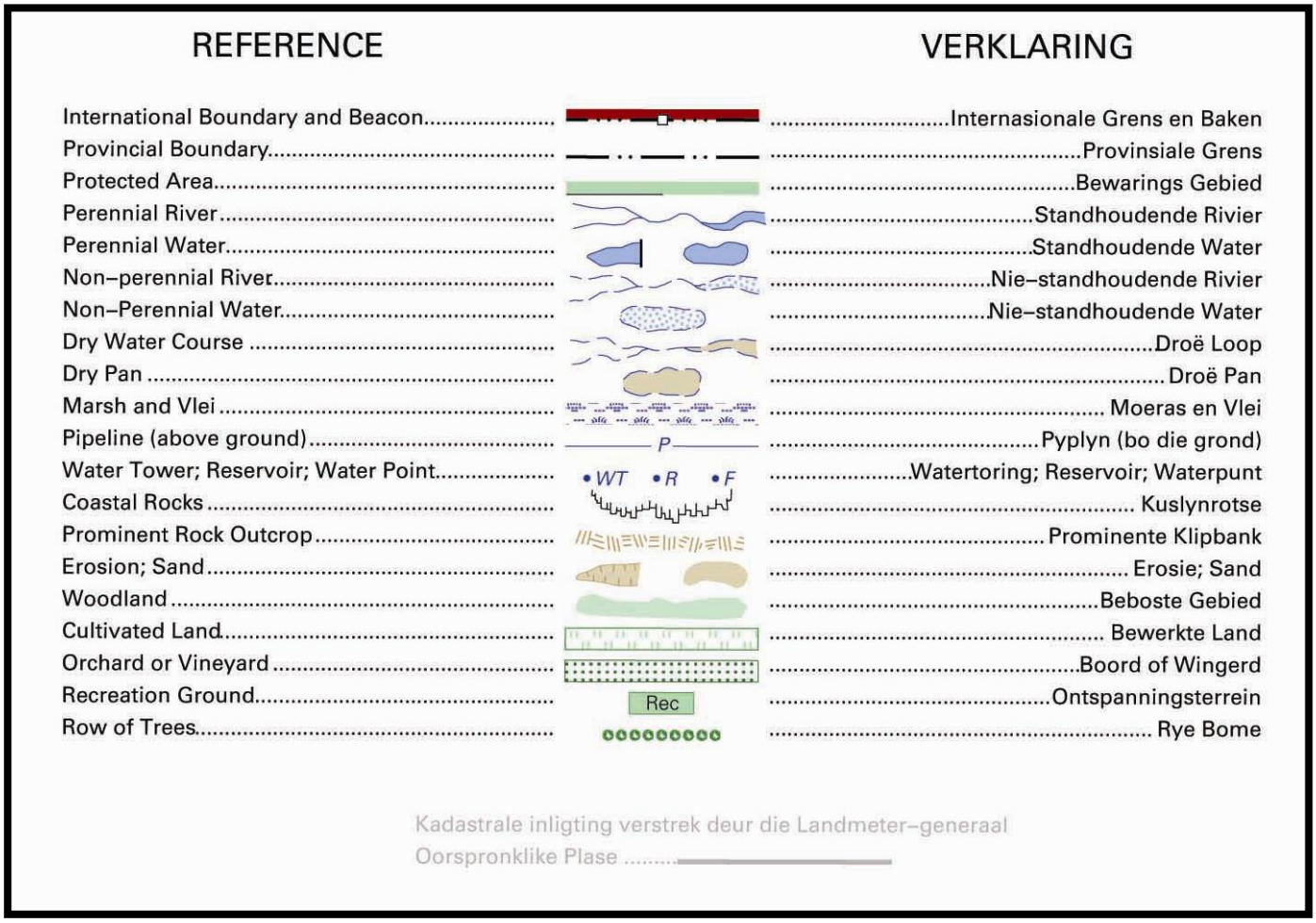
SECTION B: ADDITIONAL CONTENT NOTES

You need to know the conventional symbols of by heart. You must be able to identify them, and know what each feature that is represented by the signs function, is.

1000 Metres

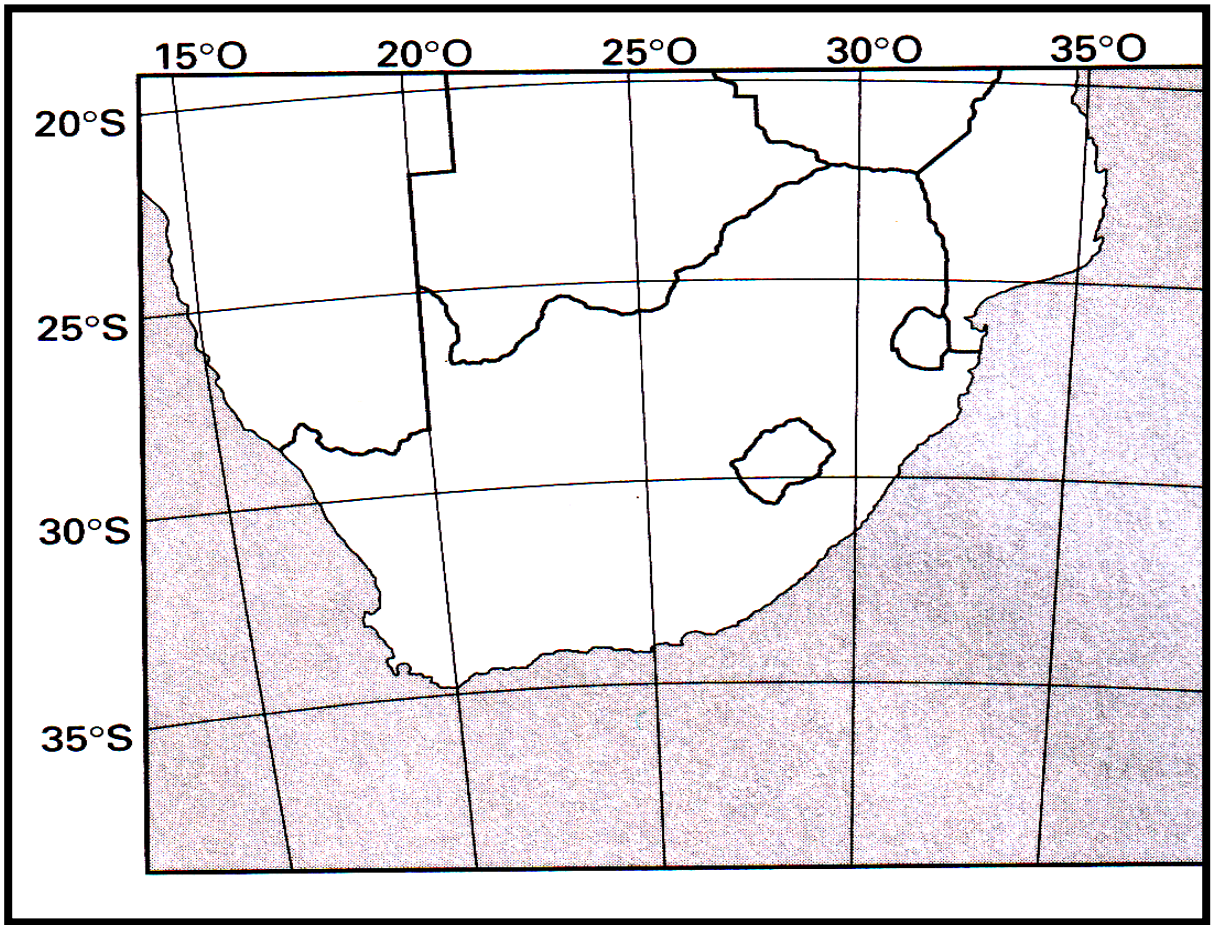
REFERENCE		VERKLARING
National Freeway; National Route		Nasionale Deurpad; Nasionale Roete
Arterial Route		Hoofverkeersroete
Main Road		Hoofpad
Secondary Road; Bench Mark		Sekondêre Pad; Hoogtemerk
Other Road; Bridge		Ander Pad; Brug
Track and Hiking Trail		Dowwe Pad en Voetslaanpad
Railway; Station or Siding		Spoorweg; Stasie of Sylyn
Other Railway; Tunnel		Ander Spoorweg; Tonnel
Embankment; Cutting		Opvulling; Deurgrawing
Power Line		Kraglyn
Built–up Area (High, Low Density)		Beboude Gebied (Hoë, Lae Digtheid)
Buildings; Ruin		Geboue; Murasie
Post Office; Police Station; Store	P PS W	Poskantoor; Polisiestasie; Winkel
Place of Worship; School; Hotel	K S H	Plek van Aanbidding; Skool; Hotel
Fence; Wall		Draadheining; Muur
Windpump; Monument		Windpomp; Monument
Communication Tower	W	Kommunikasietoring
Mine Dump; Excavation		Mynhoop; Uitgrawing
Trigonometrical Station; Marine Beacon		Peilbaken; Seevaartbaken
Lighthouse and Marine Light		Vuurtoring en Seevaartlig
Cemetery; Grave		Begraafplaas; Graf

Cadastral information supplied by the Surveyor–General
Original Farms .....



MAP CODE – EACH MAP HAS A NAME AND REFERENCE

- There are about 1916 1: 50 000 maps that cover South Africa
- South Africa is divided into 1º latitude by 1º longitude blocks. But this covers too large an area to draw a 1: 50 000 map
- The latitude longitude grid is further divided into big blocks and this is further divided into small blocks.
- Latitude and longitude is used to classify the maps and to identify specific maps
- Each map code consists of Latitude, Longitude, big block, small block and the name of the largest settlement on the map, e.g. 2529CC Witbank

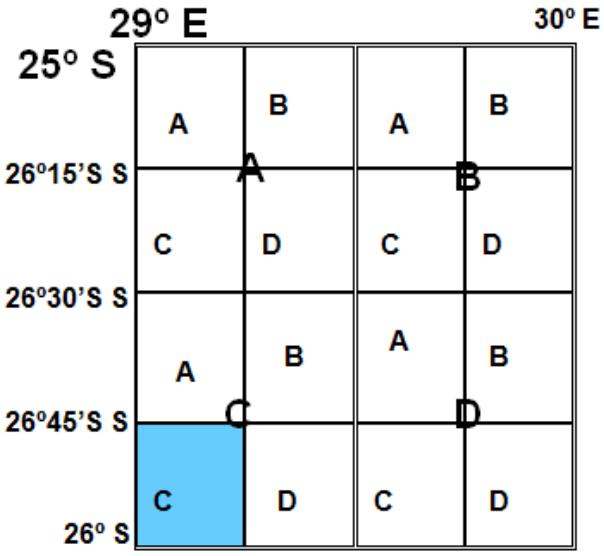


The latitudes in South Africa increase from the top to the bottom as one moves further away from the equator. The Longitudes increase from left to right as one goes further east.

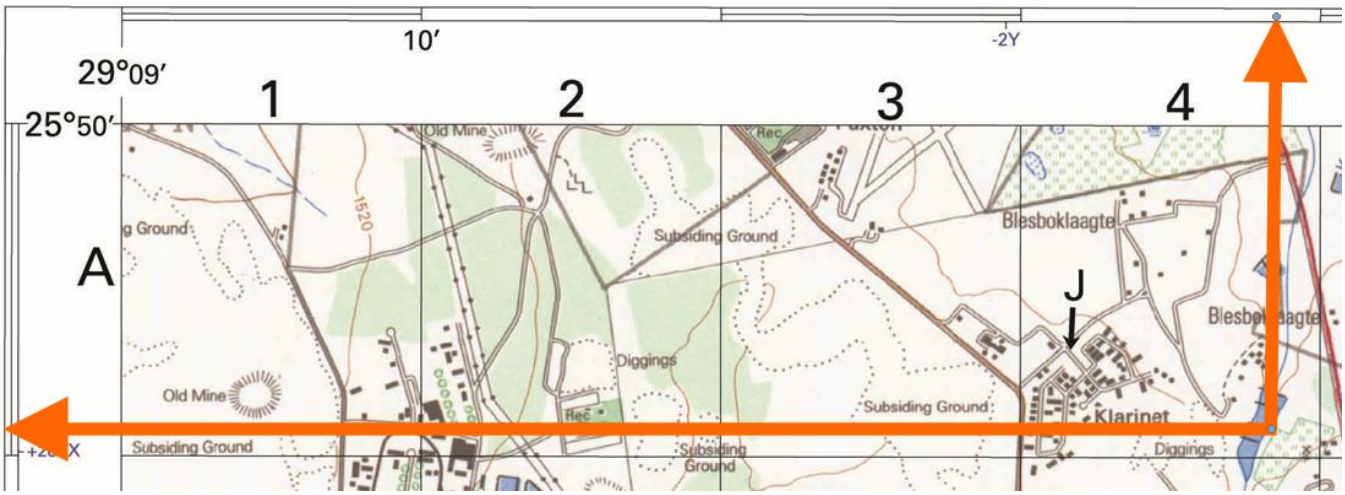
HOW IS A MAP CODE OR MAP REFERNCE NUMBER COMPILED?

Example:
2529CC Witbank

25º South – Latitude
29º East – Longitude
C – Big block - the bold A, B, C, D.
C – Small block
Witbank – settlement



Grid reference



25°50, 9'S ; 29°12,8'S
Or
25°50'54"S ; 29°12'48"S

Contour lines connect all places with the same altitude, and on the 1:50 000 there is a 20m difference (contour interval) between one contour and the next. This map is at sea level and thus the first contour would be at 20m. Notice that the contours that are on intervals of 100m are printed slightly thicker. When contours are spaced near each other, it means that the slope is very steep. If the contours are far apart, the landscape is very gradual.

The smaller contours are usually higher and represent the hill tops of the area.
When you look at a topographic map, you should see the small contours as the highest areas. Compare the spot heights in the smallest contours to identify the highest areas.

Scale

- **Large scale maps**
  - Cover a small part of reality
  - Show a lot of detail
  - Have less distortion
  - Reality not reduced so much
  - Illustrate a city, province
  - E.g. 1 : 25 000 and 1 : 50 000 maps

- **Small scale maps**
  - Cover a large part of reality
  - Show little detail
  - Have a lot of distortion
  - Reality has been reduced a lot
  - Illustrate a country, continent or the world
  - E.g. 1 : 1 000 000 and 1 : 25 000 000 maps

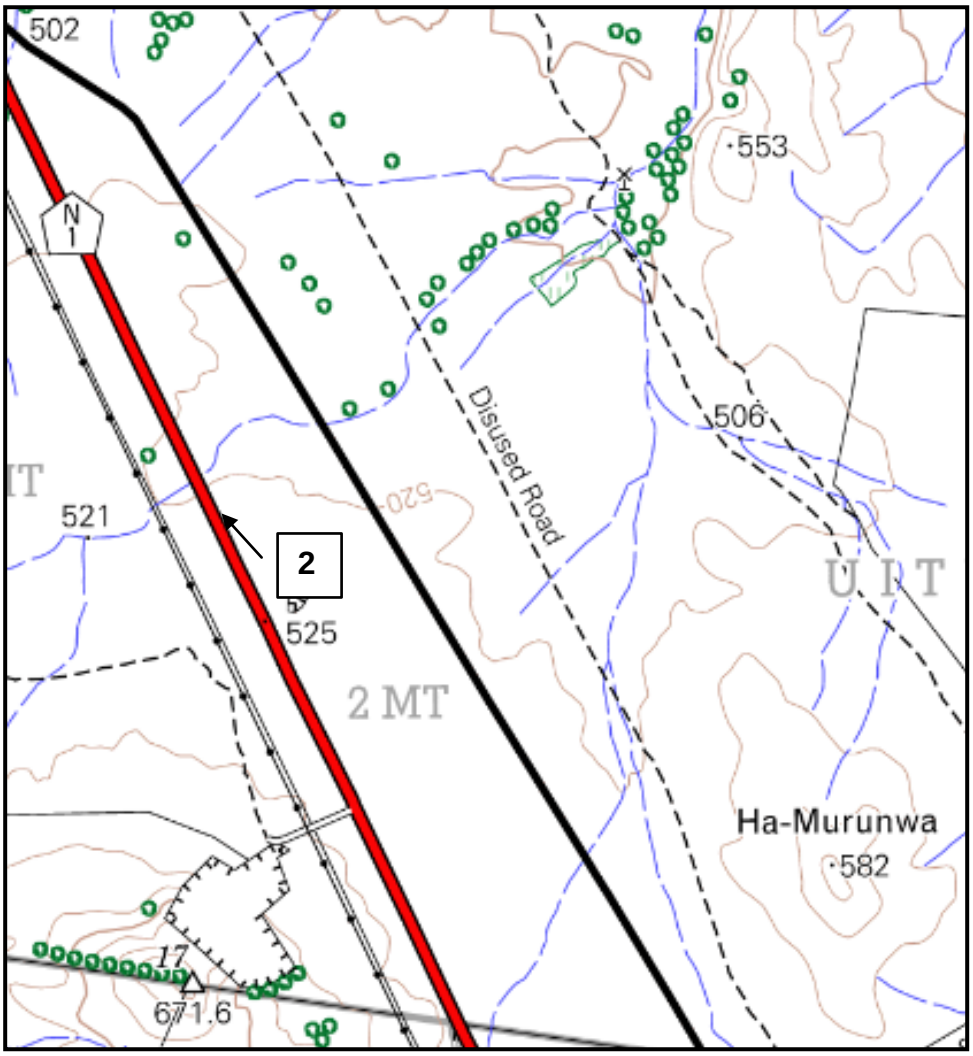
SECTION C: HOMEWORK: TOPIC 2

QUESTION 1: 30 minutes 32 marks *(Source: DoE March 2010 & November 2009)*

The following questions are based on the 1:50 000 topographical map 2230AA&AC MUSINA 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 answer and write only the letter (A – D)

1.1 What is the altitude on the trig beacon on the next map clip…?

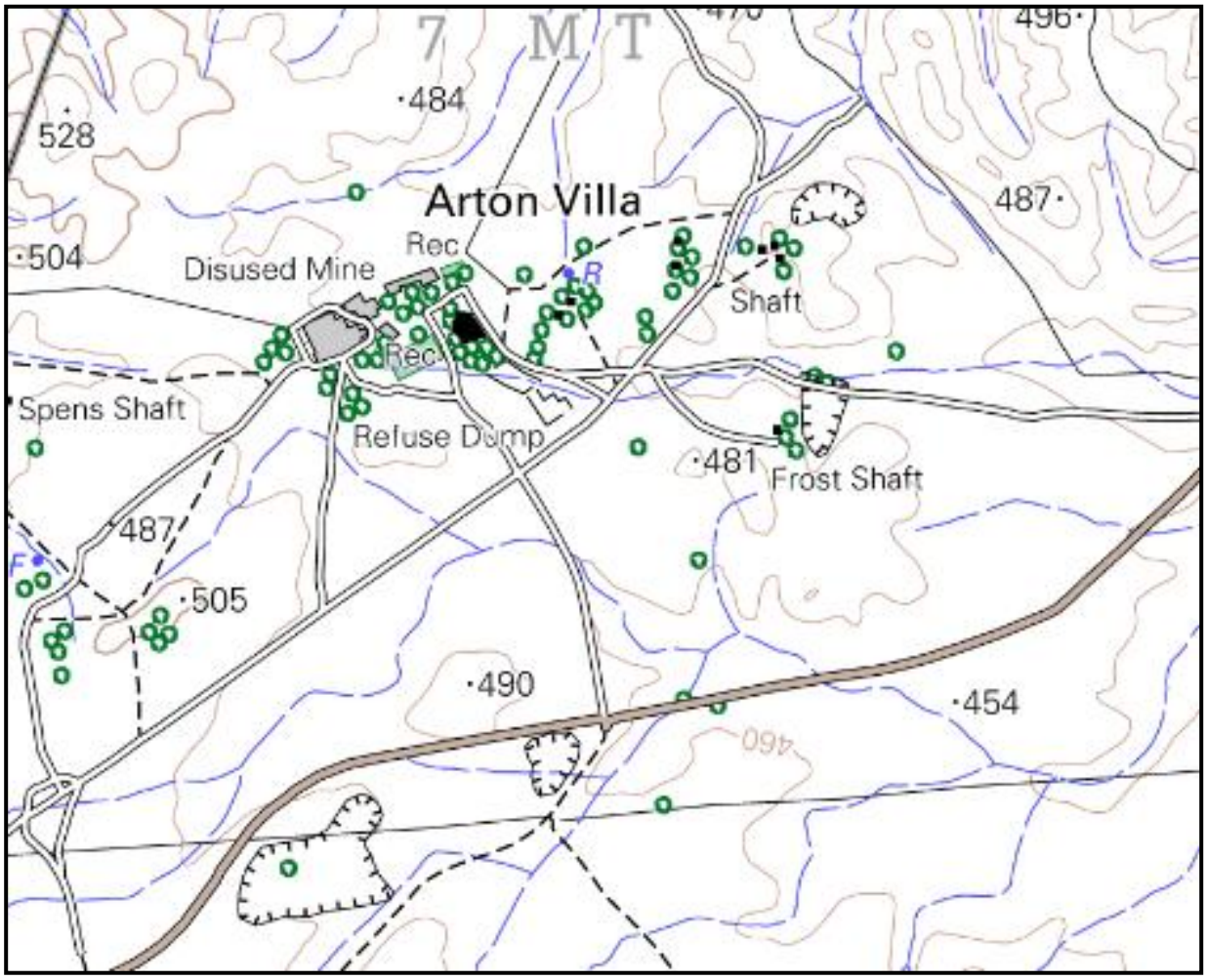
A 525 m
B 521 m
C 17 m
D 671.6 m



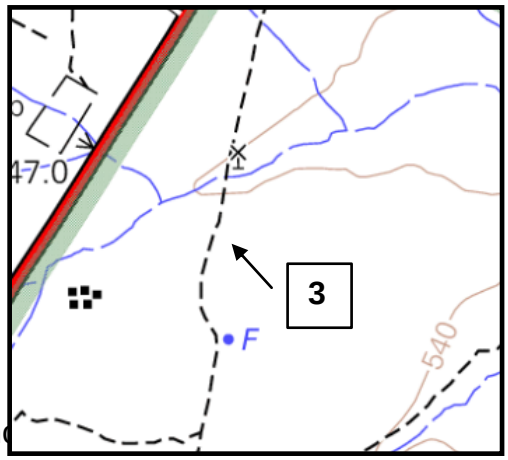
1.2 The height of the N1 National Route at 2…

A 500 m
B 520 m
C 540 m
D 560 m

1.3 The settlement of Arton Villa (F6) originally developed as a … settlement.



A mining
B farming
C resort
D junction



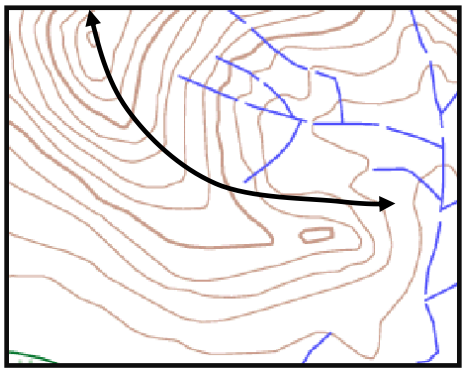
1.4 The feature numbered 3 is a …

A wind pump
B communication tower
C grave
D water tower

1.5 The word scale of the orthophoto map is: (The orth

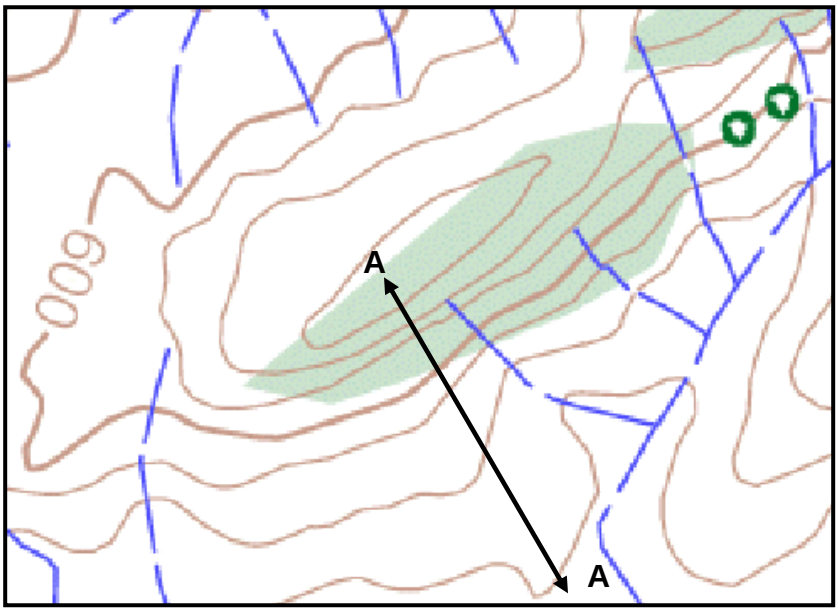
A 1 cm represents 10 000 m
B 1 cm represents 1 000 m
C 1 cm represents 100 m
D 1 cm represents 10 m

1.6 The landform in the map clip is a ... (arrow)



A cuesta
B valley
C spur
D mesa

1.7 The slope from A to B on the map is …



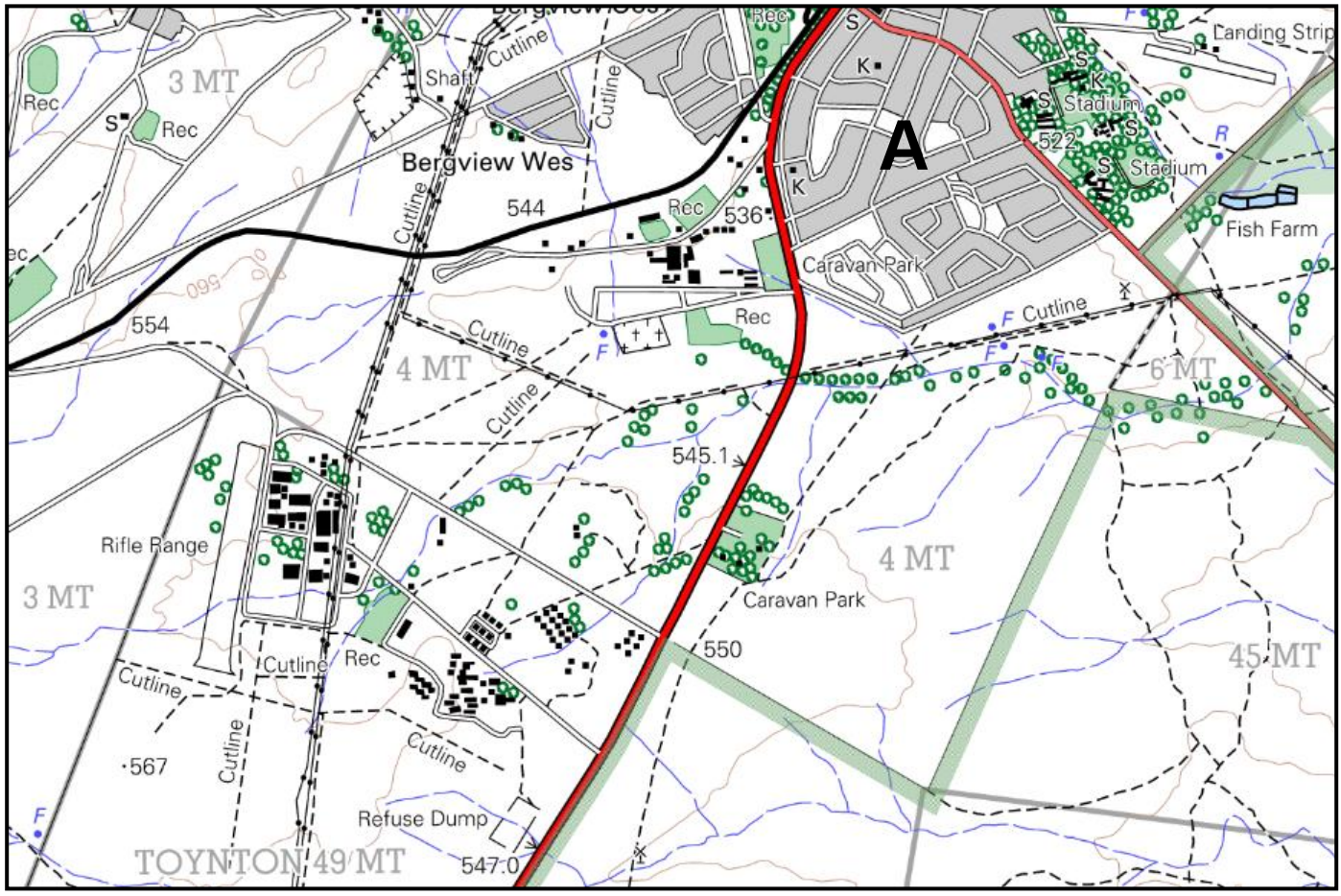
A convex
B concave
C gentle
D terraced

1.8 The direction from A to B on the map clip is …

A west-northwest
B north-northwest
C northwest
D southwest

1.9 The refuse dump at N on the orthophoto map is mainly for … waste.

A industrial
B domestic
C agricultural
D mining

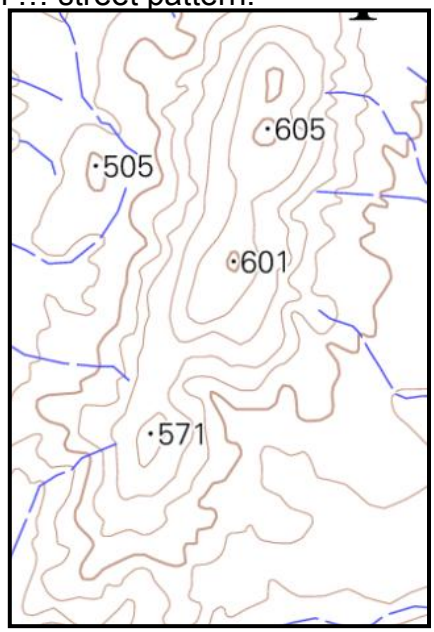


1.10 The residential area marked A on the map shows a rough … street pattern.

A grid-iron
B radial
C unplanned, irregular
D planned, irregular

1.11 The landform found between spot height 605 and spot height 601 is a …

A poort
B saddle
C spur
D valley

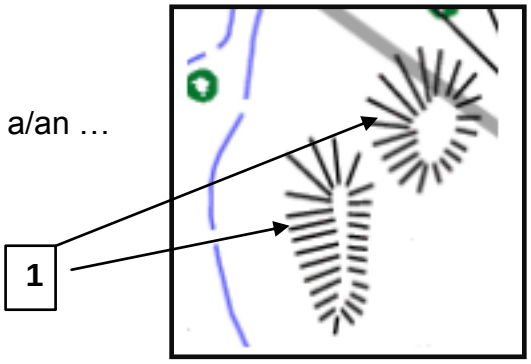


1.12 Musina is an example of a … town. (The main function is supplying the local rural community with services)

A central place
B junction
C gap
D bridge

1.13 The feature marked 1 on the topographical map is a/an …

A mine dump
B cutting
C embankment
D excavation

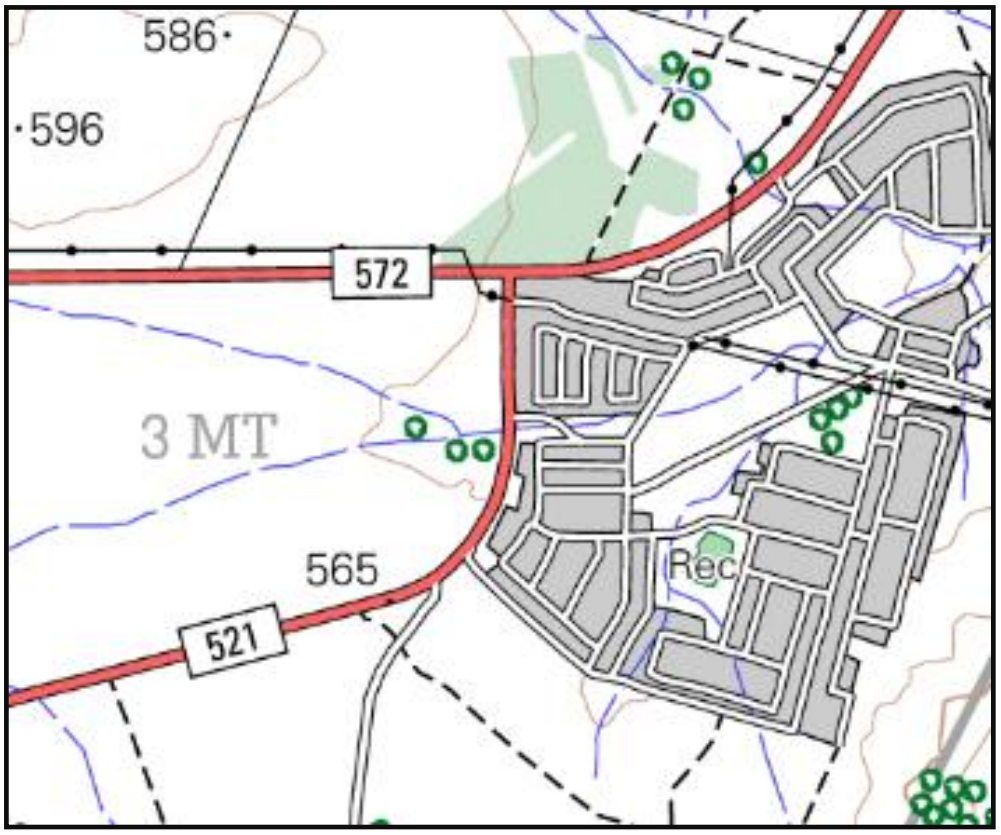


1.14 An orthophoto map is a … photograph which has contour lines, spot heights, trigonometrical stations and other labelled features drawn onto it.

A high oblique
B low oblique
C horizontal
D vertical

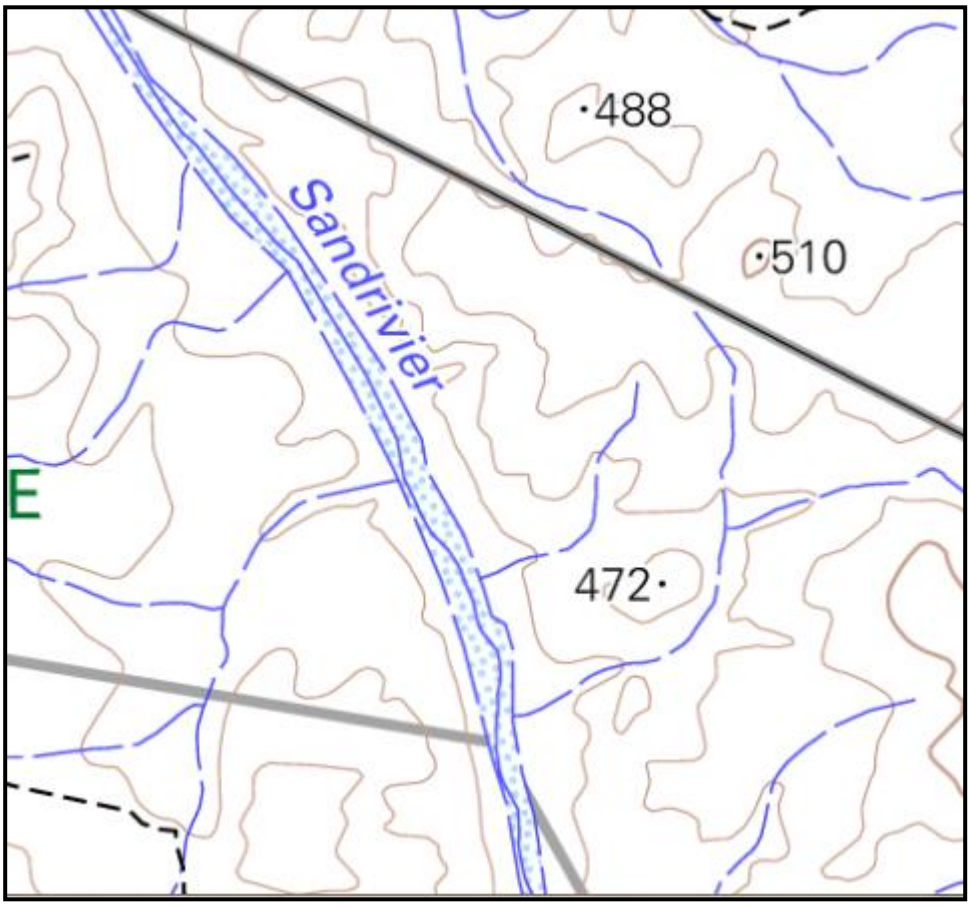
1.15 The R572 and 521Thinner red lines) on the map is a/an … roads.

A arterial
B main
C secondary
D other



1.16 The Sand River (Sandrivier) that flows in the mapped area is a/an … river.

A periodic
B episodic
C permanent/perennial
D exotic (16 x 2) [32]



SECTION D: SOLUTIONS AND HINTS TO SECTION A: TOPIC 1

QUESTION 1

1.1. D✓✓
1.2. B✓✓
1.3. B✓✓
1.4. C✓✓
1.5. B✓✓
1.6. D✓✓
1.7. C✓✓
1.8. D✓✓
1.9. C✓✓
1.10. D✓✓ (10 x 2) **[20]**

QUESTION 2

2.1. B✓✓
2.2. A✓✓
2.3. A✓✓
2.4. C✓✓
2.5. C✓✓
2.6. D✓✓
2.7. B✓✓
2.8. B✓✓
2.9. D✓✓
2.10. B✓✓ (10 x 2) **[20]**

QUESTION 3

3.1. B✓✓
3.2. D✓✓
3.3. C✓✓
3.4. B✓✓
3.5. C✓✓
3.6. B✓✓
3.7. A✓✓
3.8. A✓✓
3.9. C✓✓
3.10 A✓✓ (10 x 2) **[20]**

TOPIC 2: MAP PROJECTIONS

Learner Note: Although the map projections are hardly ever asked in exams, you should know that the Mercator is a cylindrical projection. You should also now that the Gauss conform projection is used on the topographic maps and aerial photographs

SECTION B: ADDITIONAL CONTENT NOTES

1. What are map projections?

A map projection is the method used to flatten the three dimensional sphere of the earth onto a two dimensional surface like a map sheet or a computer screen with the least distortion.

1.1. Projection Concepts

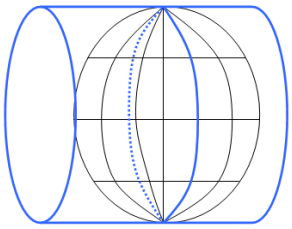
- The earth is three-dimensional and it has a spherical shape with a very uneven surface. It has length, breadth and height.
- Maps or a computer screen are two dimensional. They only have length and breadth.
- A geographic coordinate system locate places in the three dimensional reality.
- Map projections are used to convert the three dimensional reality into two dimensional models of reality, namely maps or layers in a GIS.
- During the process of modeling the dimensional reality into a two dimensional model, distortion is inevitable. Some features, however, can be conserved with specific projections.

1.2. Projection properties

- **Conformal projections maintain shape**. The shape of the country, continent or province stays true. Lambert's Conformal Conic projection conserves shape.
- **Equal-area maintains area**. The area covered by a city, district, country or continent stay true. The world map that we use most often, does not conserve area and for that reason we have the perception that Africa is smaller than many of the other continents. Africa is actually the largest continent. The Albers Equal Area projection conserves area.
- **Equidistant projections maintain distance**. Equidistant Conic projections keep distances correct.
- **Direction is difficult to maintain on small scale maps**. The Lambert Equal Area Azimuthal projection maintains some direction over smaller areas.

Different projections cause different distortions. No projections can conserve shape, distance, area and direction. Some projection conserves two properties over smaller areas.
Different projections are useful for different applications. If you are measuring the area farmers use to cultivate land in a country, you will need an equal area projection. If you are flying, you will need maps with projections that conserve distance and direction. If this is not possible, you need to determine the direction on an Azimuthal map, and the distance on an equidistant projection map.

4.3. Gauss Conformal Projection



Gauss was a mathematician who worked on a cylindrical projection to conserve scale and distance on larger scale maps. All the maps up to 1: 250 000 in South Africa use this map projection. It is also called the transverse Mercator projection where the cylinder used to project the earth is moved sideways to allow the touch lines of central meridian to run North / South. This allows for accurate distance and area calculations.

TOPIC 3: GEOGRAPHIC INFORMATION SYSTEMS

Learner Note: GIS is always 20 marks in the map work paper. You should get full marks for this as they are really easy questions

SECTION A: TYPICAL EXAM QUESTIONS

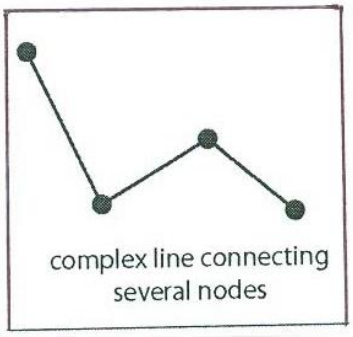
QUESTION 1: 15 minutes 20 marks *(Source: DoE Exemplar: 2008)*

1.1. Geographical Information Systems (GIS) can store, manage, analyse and display data. To manage the data in GIS, you must look at the different parts that make up the system. Name any TWO parts of GIS that make up the system. (2 x 2) (4)

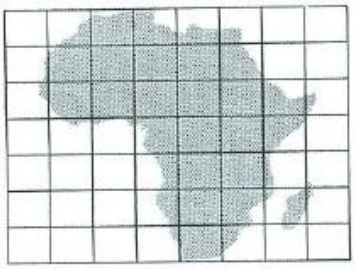
1.2 There are two main types of data, namely spatial data and attribute data. Differentiate between *spatial data* and *attribute data*. (2 x 2) (4)

1.3 State whether the following types of spatial data are vector, raster or image data.

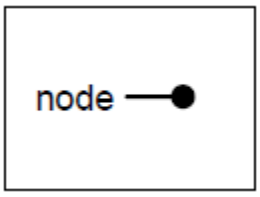
1.3.1



1.3.2



1.3.3



(3 x 2) (6)

1.4 Geographical information is obtained in a number of ways.

1.4.1 State any TWO ways in which geographical information can be obtained. (2 x 2) (4)

1.4.2 What is a *geographical database*? (1 x 2) (2)

[20]

HINTS

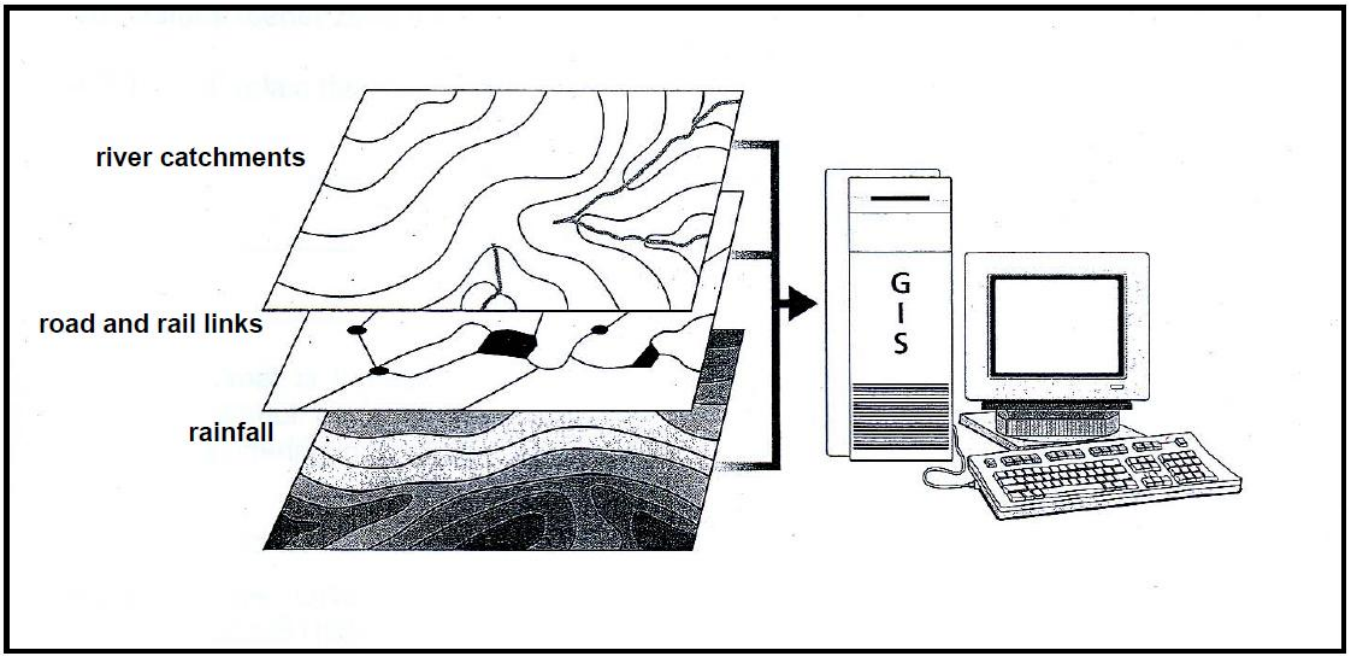
Hint 1: Know you GIS well – it is easy to get marks in this section

QUESTION 2: 15 minutes 18 marks *(Source: DoE November 2008)*

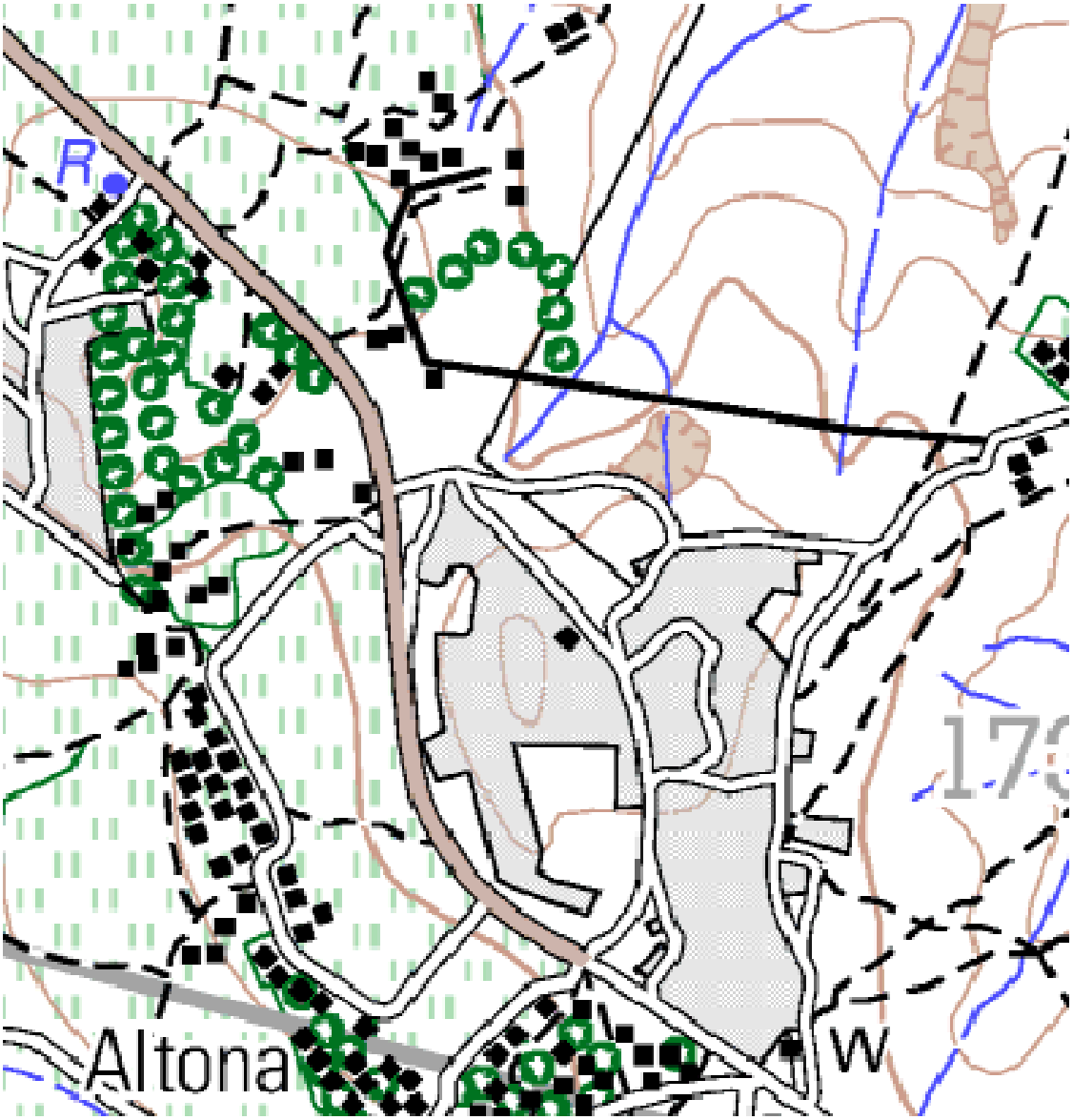
2.1 What is a Geographical Information System (GIS)? (1 x 2) (2)
2.2 Differentiate between *vector data* and *raster data*. (2 x 2) (4)
2.3 Classify the following data as vector or raster.
2.3.1. Image (1 x 2) (2)
2.3.2. Polygons (1 x 2) (2)
2.4 Name any TWO components of a GIS. (2 x 2) (4)
2.5 Your friend lives in Nompumelelo and he/she would like to open a business in the area. How could you make use of a GIS in order to ensure the success of his/her business? (2 x 2) (4)
[18]

QUESTION 3: 15 minutes 18 marks *(Source: DoE November 2009)*

3.1 Explain the difference between attributes and spatial data. (2 x 2) (4)
3.2 The diagram below illustrates the concept of data layering.



3.2.1 Explain the meaning of the term data layering. (1 x 2) (2)
3.2.2 Name any TWO layers of information that one can identify in the block from a topographical map. (2 x 2) (4)



3.2.3 Explain TWO uses of data layering in a GIS. (2 x 2) (4)

3.3. Buffering can be used in many different ways in a GIS, for example when determining the natural feeder zone for a school.

3.3.1. Explain the meaning of the term buffering. (1 x 2) (2)

3.3.3 Name ONE advantage of buffering for the school identified in QUESTION3.3.1. (1.x.2).(2)

[18]

HINTS

Hint 1: The conventional symbols are layers of vector data on a map. Some illustrate points, other lines and some areas.

QUESTION 4: 15 minutes 18 marks *(Sources: DoE March 2009)*

4.1 Give TWO examples of spatial data found on the topographical map and orthophoto map. (2 x 2) (4)

4.2 Name two data storage formats in GIS (2 x 2) (4)

4.3 State TWO processes when working with a GIS. (2 x 2) (4)

4.5 Define the term remote sensing. (1 x 2) (2)

4.6.1 Define the term spatial resolution. (1 x 2) (2)

4.6.2 Does the orthophoto map or the topographical map have a higher spatial resolution? (1 x 2) (2)

[18]

SECTION B: ADDITIONAL CONTENT NOTES

GIS: Geographic information system

- GIS is an organised collection of computer hardware, software, geographic data and personnel designed to capture, store, update, manipulate, analyse and display geographically referenced data.

Resolution:

- The detail depicted on a Vector map – larger scale allow higher resolution
- The size of the pixels of a raster image
  - High resolution – many small pixels cover the area
  - Low resolution – fewer large pixels cover the same area.

The implications of spatial resolution

- Raster detail is linked to spatial resolution
- Raster detail is limited by pixel size
- The smaller the pixel size the more the detail
- The smaller the pixel the higher the resolution and the more space it takes to store the images on a computer hard drive
- Scale influence the choice of the resolution but scale and resolution is not the same.

Remote sensing

- Observe the earth from a distance through satellites or aeroplanes
- Captured as Raster data at different spatial resolutions
- Capture data and derive information about the physical, chemical and biological properties of the objects from a distance.
- Used to study landscapes, ecosystems, hydrology, atmosphere, climatic change, human development and the impact of humans on the environment.
- Different sensors are used to capture data
  - Camera – Aerial photographs
  - Electro-optical sensors record visible light and infrared,
- Different spectral resolutions can detect different features (Enhanced thematic mapper on Landsat) Radar, Thermal and Sonar

Spatial and Attribute Data formats

Spatial data refers to the shape and location of geographical features on earth. The information is linked to place on earth – Georeferenced data. This can be in raster format or vector format. Rasters consist of equal sized cells called pixels arranged in a Georeferenced grid. Vector data consist of points, lines or polygons illustrating real world features called entities. The attributes can be displayed on a map as labels, unique or graduate colours or symbols indicating size, order or intensity. The information on in the table then becomes visible on the map. This is called visualisation. See map and table of Africa.

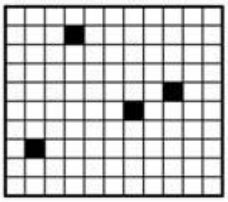
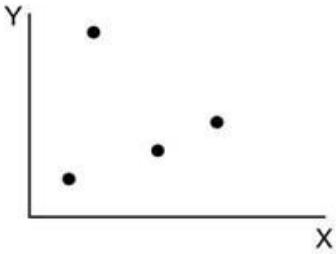
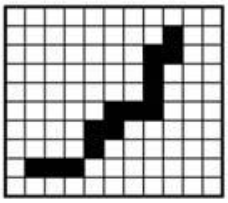
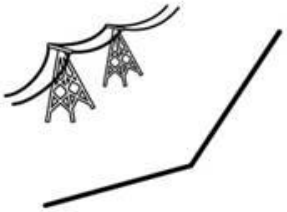
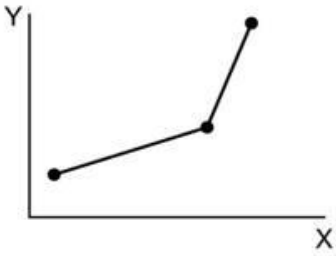
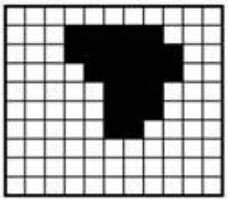
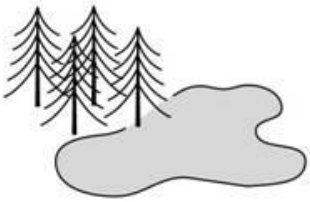
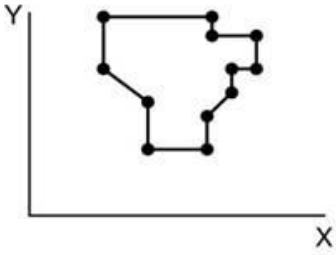
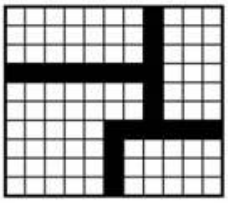
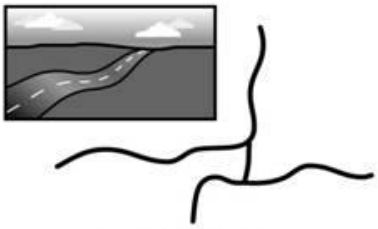
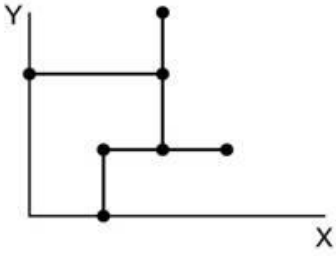
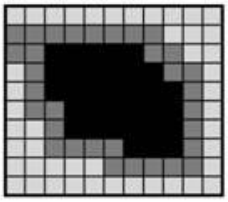
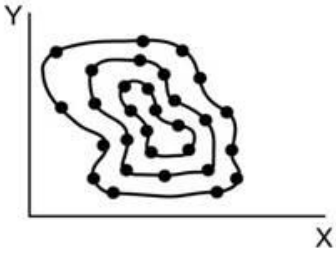
Attribute data describes the points, lines, polygons or pixels that illustrate real world features. Attributes can identify, measure, order or categorise features. Attribute data is stored in tables that are linked to the spatial data (vector or raster). A table has a specific structure: It consist of columns called fields (vertical) with fieldnames as headings, which organise the different types of attributes of features. A table has rows (horizontal) which store the attributes of a specific real world entity. The attributes of points, lines, polygons or pixels cannot be stored in one table. One table can only store the attributes of a set of lines or points or polygons or pixels. An attribute table is linked to a layer of spatial information in the GIS. Selection can be made according to the attributes, e.g. select all the countries with a population larger than 1 000 000.

Raster data:

Raster data consist of (equal sized blocks) pixels in a grid. This is usually aerial photographs, satellite images or models like Digital Elevation Models. A raster is an image or model that covers the whole surface of the area in the GIS. The spatial resolution will determine how much detail is visible on the image. It is especially useful to study features without clear boundaries like vegetation, soil types, temperature etc. It is very useful for environmental studies. Raster images form one of the most important input sources in GIS.
The image below is a sun-shaded DEM of South Africa. Each pixel has a value which is the altitude of the pixel.

Vector Data:

Vector data is modelled on a Cartesian plane (x,y axis in maths) as points, lines and polygons. A point consists on one coordinate. Lines consist of a start node and an end node, as well as vertices where the line change direction and chains connecting the nodes and vertices. Polygons are the same as lines, but the start and end node has the same coordinate to enclose the area illustrated by the polygon. The sketches that follow show the difference between raster and vector format data.

The raster view of the world	Happy Valley spatial entities	The vector view of the world
	 Points: hotels	
	 Lines: ski lifts	
	 Areas: forest	
	 Network: roads	
	 Surface: elevation	

Vector	Raster
▪ Points lines and polygons ▪ Coordinates ▪ Simplified reality – only applicable features ▪ Model entities with clear boundaries best, e.g. land uses, country boundaries, cities ▪ Accurate distance measurements ▪ Easy to do accurate buffers ▪ Difficult to calculate area ▪ Takes up less space in a database ▪ Measured with GPS or by surveyors ▪ Looks more like a map ▪ Digitising result in vector layers	▪ Pixels in a grid ▪ Complex reality ▪ Models continuous entities with no clear boundaries, e.g. vegetation, elevation, temperature, soils ▪ Inaccurate distance measurements, ▪ Easy to calculate area and do overlays if spatial resolution same ▪ Takes up large amounts of space in a database if it has a high spatial resolution ▪ Scanning result in raster images ▪ Can use overlays to do map maths

The components of GIS:

- Hardware – equipment like computers, printers, plotters, scanners, digitising tables, GPS devices etc.
- Software – the programs to operate the GIS, e.g. database and GIS computer programs – ArcInfo, MIPS, IDRISI, Google Earth, QGIS, Planet GIS,
- Data - spatial and attribute data (facts) that is captured and stored in the GIS about the earth
- People and organisations - clever users that utilise the data, hardware and software to make intelligent or wise decisions for their governments, companies or organisations
- Processes - the methods of working with the data and software to ensure reliable unbiased results in different situations.
- Applications - different fields of study where GIS is used and applied, e.g. city planning, forestry etc.

Sources of information for GIS

The data in a GIS can be gathered from numerous sources:

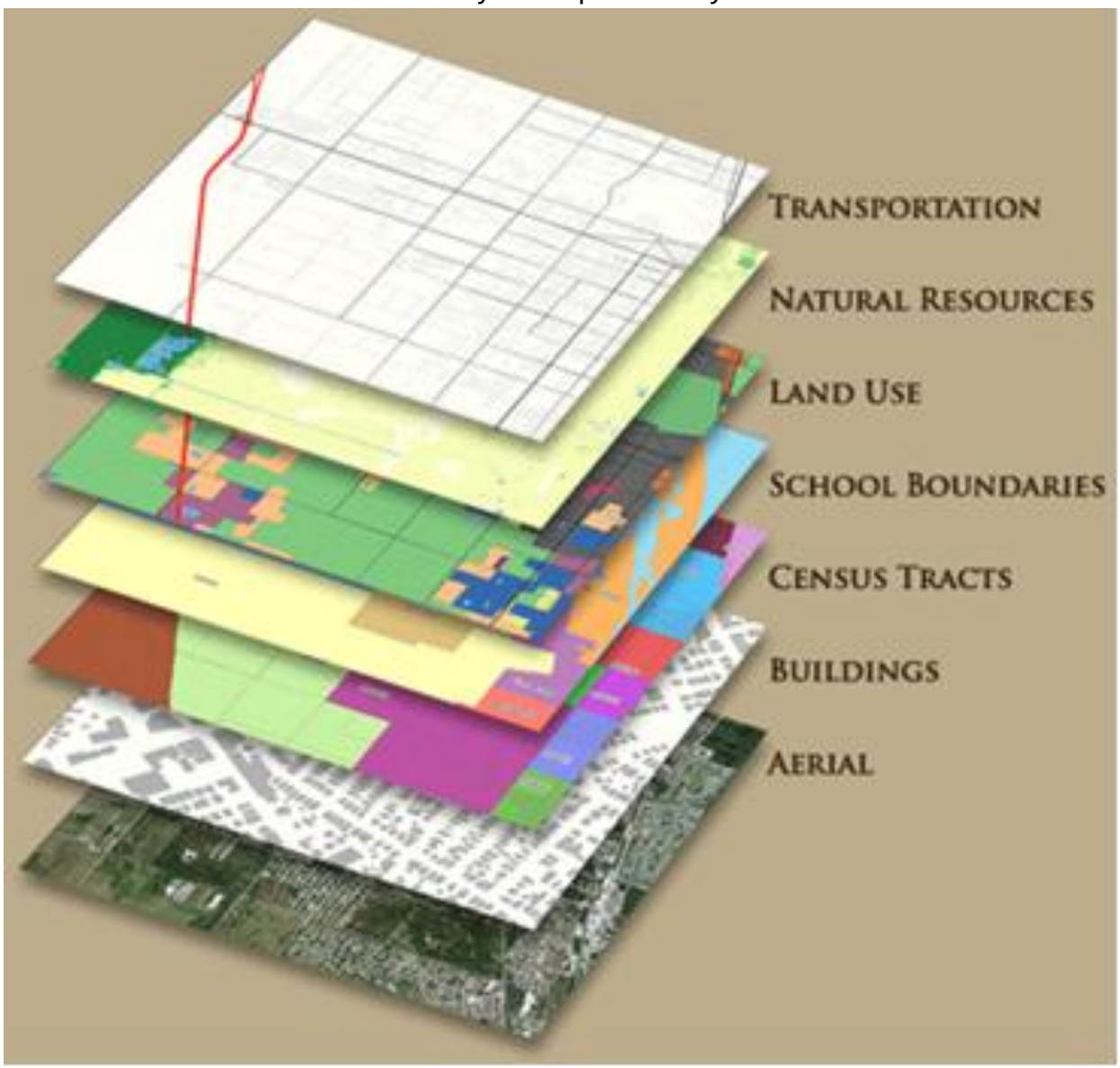
- Primary data – first hand observations and measurements
  - Surveying, GPS points, surveys, measurements, tests, sketch maps, census
- Secondary data – existing data measured and captured by another organisation
  - Topographic maps, satellite images, attribute data in tables, models, newspaper articles

Primary data	Secondary data
▪ Observed first hand ▪ Measurements ▪ GPS readings ▪ Land surveying ▪ Surveys ▪ Aerial photos ▪ Satellite images ▪ Expensive ▪ Labour intensive ▪ Need specialist to perform task ▪ Need specialist equipment ▪ Need exact measuring and capturing methods	▪ Bought or obtained from a data custodian ▪ Digital file transfers ▪ Scanned maps and photographs ▪ Digitised topographic maps ▪ Digital (elevation, temperature, evaporation, aspect) models ▪ Less expensive ▪ Not always compatible files ▪ May have different resolution than required ▪ May not cove extent required ▪ Need metadata to ensure that data is suitable ▪ May have wrong projection

Data layering

Data layering is the method used in GIS to organise different real world features in the database. Each layer consists of a set of points, lines, polygons or pixels. An attribute table is attached to the spatial data layer in the database. Computer file systems can only deal with the different vector and raster data formats as different files. Each layer is a file on the computer. Layering allows you to organise, categorize and display the different layers. The layers are listed in the table of contents (key / legend) and can be switched on or off. If a layer is on, it can be seen on the screen of the computer. The order of the layers will determine which layers are above others. In the example below, the school layer will be at the top of the legend and will also then be displayed as the top layer. It is best practice to organise raster layers at the bottom, then polygons above that, lines above polygons and points right at the top to prevent some information being obscured by other layers.

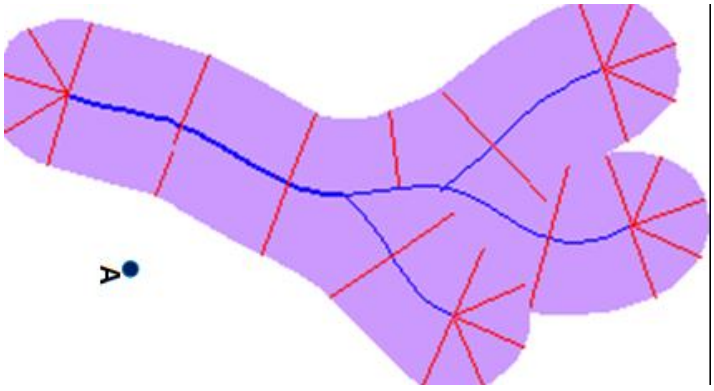
Layering allows you to isolate just one layer or a few layers and compare the relationship between the entities in the different layers – spatial analysis.



DATA MANIPULATION AND ANALYSIS

Data manipulation involves getting the different data sources in such a format that it can be integrated. You may have a paper map, hard copy aerial photograph, measured GPS points and tabulated attribute data of features which all need to get into digital files that can be read, **Georeferenced** and opened by the GIS software that you use. **Statistical data** will also have to be manipulated to be in such a file format that it can be used in the GIS software and linked to spatial features. During this phase the data is styled in such a way that it is easier to read the resultant maps. Appropriate symbols are chosen to display the entities. Manipulation also involves processes like clipping, stretching, adding labels and tiling mosaicking the data.
Errors in the database must be eliminated during manipulation.
When all the data layers are in similar data files the data can **be integrated** (put together). The different layers may have different scales, resolutions and projections. During the process of data integration the differences are illuminated and the data is fitted on top of each other and aligned according to one projection and set of coordinates.
After all this has been done, the **analysis** process can start. Analysis reveals patterns that are not immediately visible. They must be manipulated in order to make the spatial patterns visible. **Spatial analysis** use **overlays** of different layers and other techniques to extract new spatial information. The relationships between different spatial data layers become apparent through spatial analysis. **Statistical analysis** reveals new information about the physical features deduced from the statistical attributes.

Buffers are areas measured in distance or time around a feature of interest. Buffers are used for proximity analysis.
The sketches below illustrate how a buffer is drawn around a river. Say there is a law which states that no natural vegetation may be taken out within a specific distance from rivers; buffers can be drawn to identify these areas. No farming or development may take place within this area. Buffers can be drawn around points and lines, but also inside a polygon at different distances.



SECTION C: HOMEWORK

QUESTION 1: 15 minutes 16 marks *(Source: DoE Prelim 2008)*

1.1 Explain the following concepts:
- 1.1.1 Geographic information systems (GIS) (1 x 2) (2)
- 1.1.2 Remote sensing (1 x 2) (2)

1.2 Differentiate between *vector data* and *raster data*. (2 x 2) (4)

1.3 Name ONE of the main data inputs of a GIS. (1 x 2) (2)

1.4 Classify the following data as either spatial data or attribute data.
- (a) A map showing housing density (1 x 2) (2)
- (b) The shape of a ploughed field (1 x 2) (2)

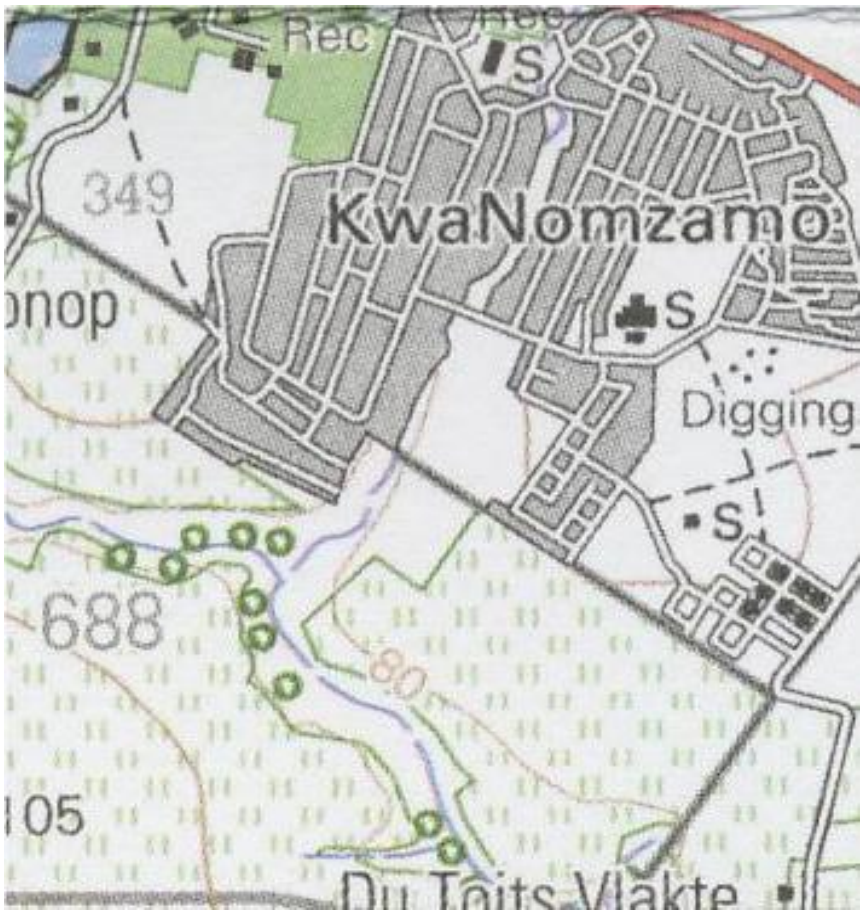
1.5 Give ONE example of possible spatial data found in or around the school on the topographical map. (1 x 2) (2)

[16]

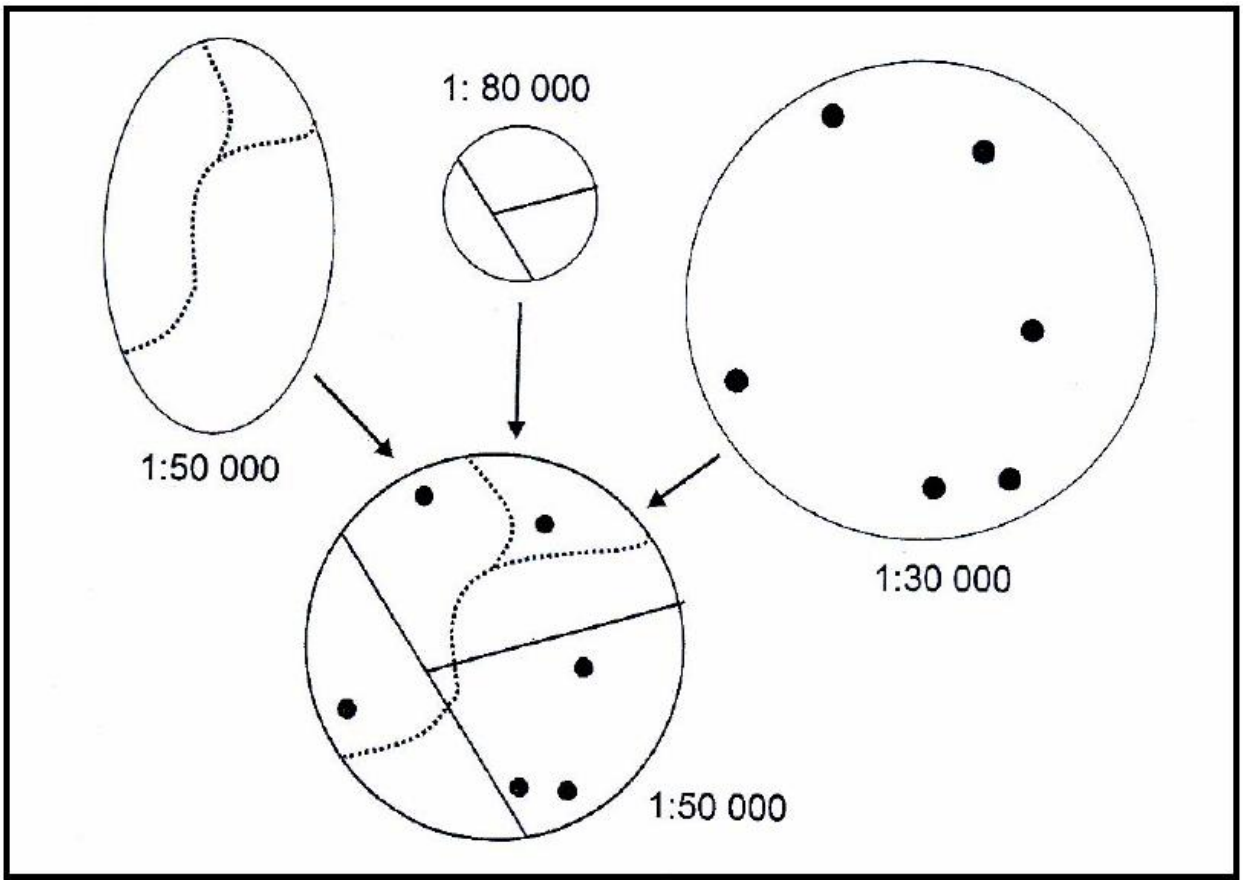
QUESTION 2: 15 minutes 20 marks *(Source: DoE March 2010)*

2.1 Name any TWO components of a GIS. (2 x 2) (4)

2.2 Identify a polygon feature, a line feature and a point feature respectively in the block below. (3 x 2) (6)



2.3 The diagram below illustrates the concept of data integration. Study the diagram carefully and answer the questions that follow.



2.3.1 Explain what is meant by data integration. (1 x 2) (2)

2.3.2 Name ONE problem that was experienced with data integration prior to the introduction of GIS. (1 x 2) (2)

2.3.3 Of what importance is data integration to a geographer? (1 x 2) (2)

2.4 What is a database? (1 x 2) (2)

2.5 Why is it sometimes necessary to manipulate data in a database? (1 x 2) (2)

[20]

QUESTION 3: 10 minutes 10 marks

3.1. What is a map projection? (1 x 2) (2)

3.2. Name any cylindrical projection. (1 x 2) (2)

3.3. Which projection is used for the topographic maps and orthophotographs? (1 x 2) (2)

3.4. Why are the projection identified in 1.3 used on 1:50 000 topographic maps? (2 x 2) (4)

[10]

HINTS - Projections

Hint 1 The map projections are hardly ever asked in exams.

Hint 2 Gauss Conform is always used on topographic maps as it conserves direction, bearing, distance and area on large scale maps to a large degree.

SECTION D: SOLUTIONS AND HINTS TO SECTION A : TOPIC 2: GIS

QUESTION 1

1.1 Hardware ✓✓
Software ✓✓
Data ✓✓
People ✓✓
Methods ✓✓
[Any TWO] (2 x 2) (4)

1.2 **Spatial data** refers to information linked to a specific location through co-ordinates and represented by points, lines or polygons ✓✓
Attribute data refers to a descriptive quality or characteristic ✓✓ (2 x 2) (4)

1.3.1 Vector data ✓✓
1.3.2 Raster data ✓✓
1.3.3 Vector data ✓✓ (3 x 2) (6)

1.4.1 Surveys ✓✓
Maps ✓✓
Aerial photographs ✓✓
Fieldwork ✓✓
Statistics ✓✓
Administrative records ✓✓
Satellite Images ✓✓
[Any TWO] (2 x 2) (4)

1.4.2 Digitally recorded information from sources such as maps, photographs, satellite images and so forth ✓✓ (1 x 2) (2)

[20]

QUESTION 2

2.1 GIS is a computer-based technology and method for collecting, analysing, managing, modelling and presenting geographical data for a wide range of users ✓✓ [CONCEPT] (1 x 2) (2)

2.2 Vector: Real world is shown by means of points, lines and polygons ✓✓
Raster: Real world features shown by means of pixels ✓✓
[CONCEPT] (2 x 2) (4)

2.3.1 Image Raster ✓✓ (1 x 2) (2)

2.3.2 Polygons Vector ✓✓ (1 x 2) (2)

2.4. People / users ✓✓

Software / computer programmes ✓✓
Data / information / maps / photos ✓✓
Applications ✓✓
Hardware / computer ✓✓
Procedure ✓✓ [ANY TWO] (2 x 2) (4)

2.5 Find information about other existing businesses (competition) ✓✓
Find the total population in order to analyse the potential market ✓✓
Find financial statistics that show growth ✓✓
Determine income of people in order to establish whether business will be feasible ✓✓
Determine demand for business ✓✓
Work out routes for deliveries ✓✓
Find ideal location for business ✓✓
Determine crime hotspot areas ✓✓ (ANY TWO. Any reasonable answers) (2 x 2) (4)
[16]

QUESTION 3

3.1 Spatial data: Data that can be specified by referring to geographic locations ✓✓ [CONCEPT]
Attribute data: Data that is described in words, numbers and pictures ✓✓ [CONCEPT] (2 x 2) (4)

3.2.1 Maps showing different types of information are projected onto one another/placed on top of one another ✓✓ [CONCEPT] (1 x 2) (2)

3.2.2 • Vegetation ✓✓
• Drainage ✓✓
• Cultivation ✓✓
• Relief ✓✓
• Infrastructure (roads, railway lines, etc.) ✓✓
• Land-use ✓✓
• Built-up areas ✓✓ [Any TWO] (2 x 2) (4)

3.2.3 Different sets of data can be compared ✓✓
Relationships between different sets of data can be established ✓✓
Analysing different sets of information ✓✓
Comparisons can assist with future developments ✓✓
[Any TWO. Accept others] (2 x 2)4)

3.3.1. Drawing of rings around features at a specific distance/process of creating areas of calculated distances from a feature/process of demarcating a specified area around a feature ✓✓ [CONCEPT] (1 x 2) (2)

3.3.2 Determine possible number of households/ learners in feeder zone ✓✓
Assist with admissions to the school ✓✓
Planning possible transport routes to and from school ✓✓
Planning of additional schools ✓✓
Determine distance learners must travel to school ✓✓
[Any ONE. Accept others] (1 x 2) (2)
[18]

QUESTION 4

4.1. Roads ✓✓
Rivers✓✓
Houses or buildings ✓✓
Parks ✓✓
Dams ✓✓ [ANY TWO - Accept other] (2 x 2) (4)

4.2. vector ✓✓
raster ✓✓ (2 x 2) (4)

4.3 Data input ✓✓
Data storage ✓✓
Data manipulation ✓✓
Data analysis ✓✓
Output information ✓✓
Data management ✓✓
Data application ✓✓ [Any TWO] (2 x 2) (4)

4.4 Refers to the observation of the earth from a distance using satellites to gather information without having direct contact with an area ✓✓
[CONCEPT] (1 x 2) (2)

4.5.1 Refers to the detail with which a map depicts the location and shape of the feature ✓✓ [CONCEPT] (1 x 2) (2)
4.5.2 Orthophoto map ✓✓ (1 x 2) (2)
[18]

TOPIC 1: RIVER SYSTEMS AND RIVER SYSTEM MANAGEMENT

Learner Note: Make sure you know the terminology very well. You should be able to identify features on sketches and explain the processes involved.

SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: **5 minutes** **10 marks** *(Source: Exemplar 2008)*

1.1. Indicate whether the following statements are true or false:

1.1.1. An aquifer is a rock that is impermeable and does not allow water to move through it.

1.1.2. A flow hydrograph records how much water passes a given point in a given period of time.

1.1.3. A periodic river is a river that only flows in the rainy season when it receives ground water.

1.1.4. Rocks that are uniformly resistant and exposed to the same type of weathering will weather at different rates.

1.1.5. The water table indicates the level of water on the surface of the earth. (5 x 2) [10]

HINTS

Hint 1 - You need to know the terminology in geomorphology off by heart. Study the definitions

Hint 2 - Make sure you have a picture that you can associate with the concept.

QUESTION 2: **20 minutes** **28 marks** *(Source: DoE Exemplar 2008)*

Refer to the extract on the following page, as well as the photograph and diagram of rivers draining into the Hartbeespoort Dam.

100 000 lives at risk

In the summer rainfall regions the lives of some 100 000 people are at risk. They are in danger because they live in flood-prone areas. One of these areas, with 6 000 residents, is an informal settlement below the banks of the Jukskei River within Alexandra Township, north of Johannesburg.

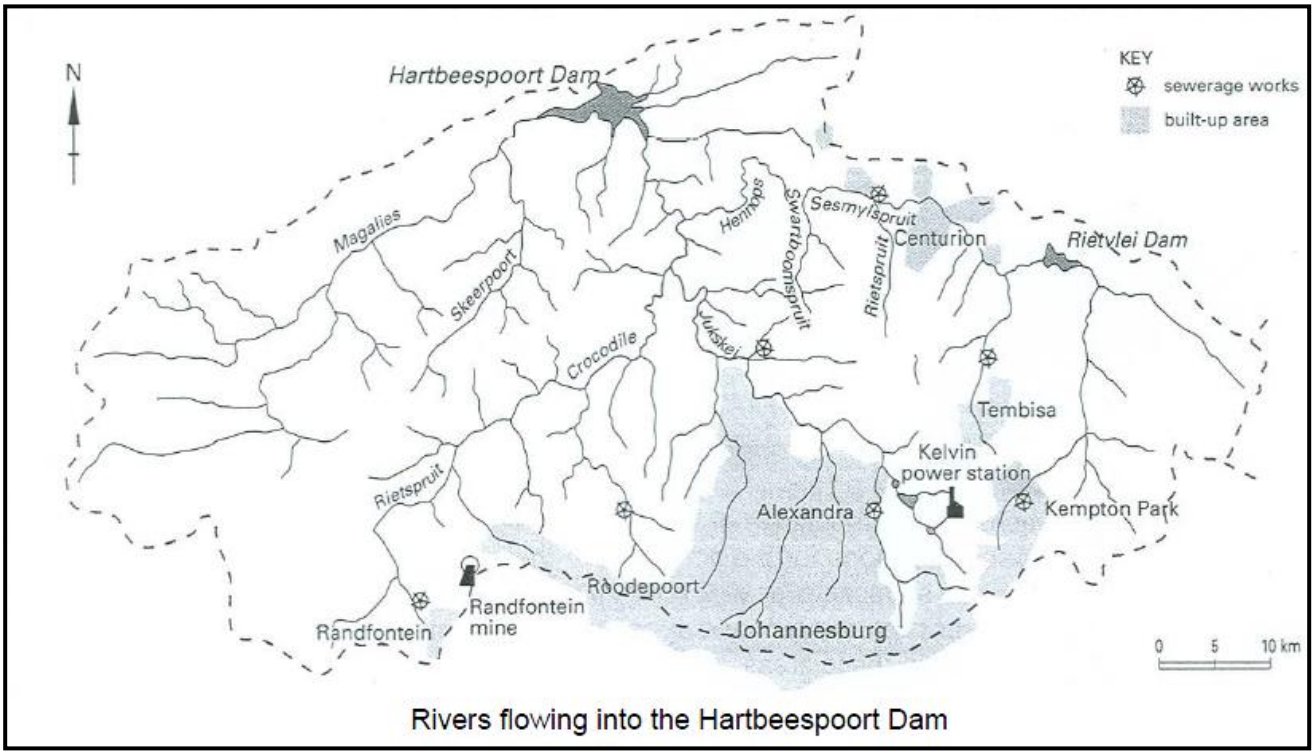
Residents have been warned many times about the dangers of building along the banks of the Jukskei, but they stay because there is nowhere else for them to go. Hundreds of shacks on the river banks have been washed away in the past yet residents remain undaunted and return to build.

Living on the edge – Alexandra residents exist dangerously on the banks of the Jukskei River

This FIGURE shows the Jukskei River and other rivers that drain into the Hartbeespoort Dam.

The Jukskei River carries heavily polluted water into the dam. The sources of this pollution are from sewerage, domestic waste and detergents reaching the river from Alexandra Township, as well as effluent from mining areas and idustrial waste from the Kelvin power station and the industrial areas of Johannesburg. There are also many sewerage works along the rivers that flow into the dam.

Heavy rains in 1999, 2000 and 2001 have caused loss of life and homes along the Jukskei River in Alexandra. Building on a flood plain, so close to the river, is hazardous. As the Jukskei River rises north of Alexandra, rainwater does not infiltrate due to the impermeable artificial surfaces of the built-up area. Overland flow occurs and as a result there is a short lag time and high flood peak in the rivers as it flows through the township, which contributes to the heavy flooding experienced.



Rivers flowing into the Hartbeespoort Dam

2.1. (a) Identify the drainage pattern of the Jukskei River as seen in the figure above. (1 x 2) (2)

(b) Give ONE reason for your answer to QUESTION 2.1. (a). (1 x 2) (2)

2.2 (a) Flooding is common in Alexandra. What is a *flood*? (1 x 2) (2)

(b) Why do people still build shacks on the banks of the Jukskei River if the area is threatened by constant flooding? (1 x 2) (2)

(c) Explain why there is a short lag time and a high flood peak as the Jukskei River flows through Alexandra. (3 x 2) (6)

(d) Name any TWO consequences of flooding for the inhabitants of Alexandra. (2 x 2) (2)

2.3 (a) Describe the locations of the sewerage works in relation to the rivers shown in the figure above (1 x 2) (2)

(b) What are the consequences of the above for people living on the banks of the Hartbeespoort Dam? (2 x 2) (2)

(c) State TWO measures that can be introduced by the provincial government to ensure that all rivers flowing into the Hartbeespoort Dam are free of sewerage effluents. (2 x 2) (2)

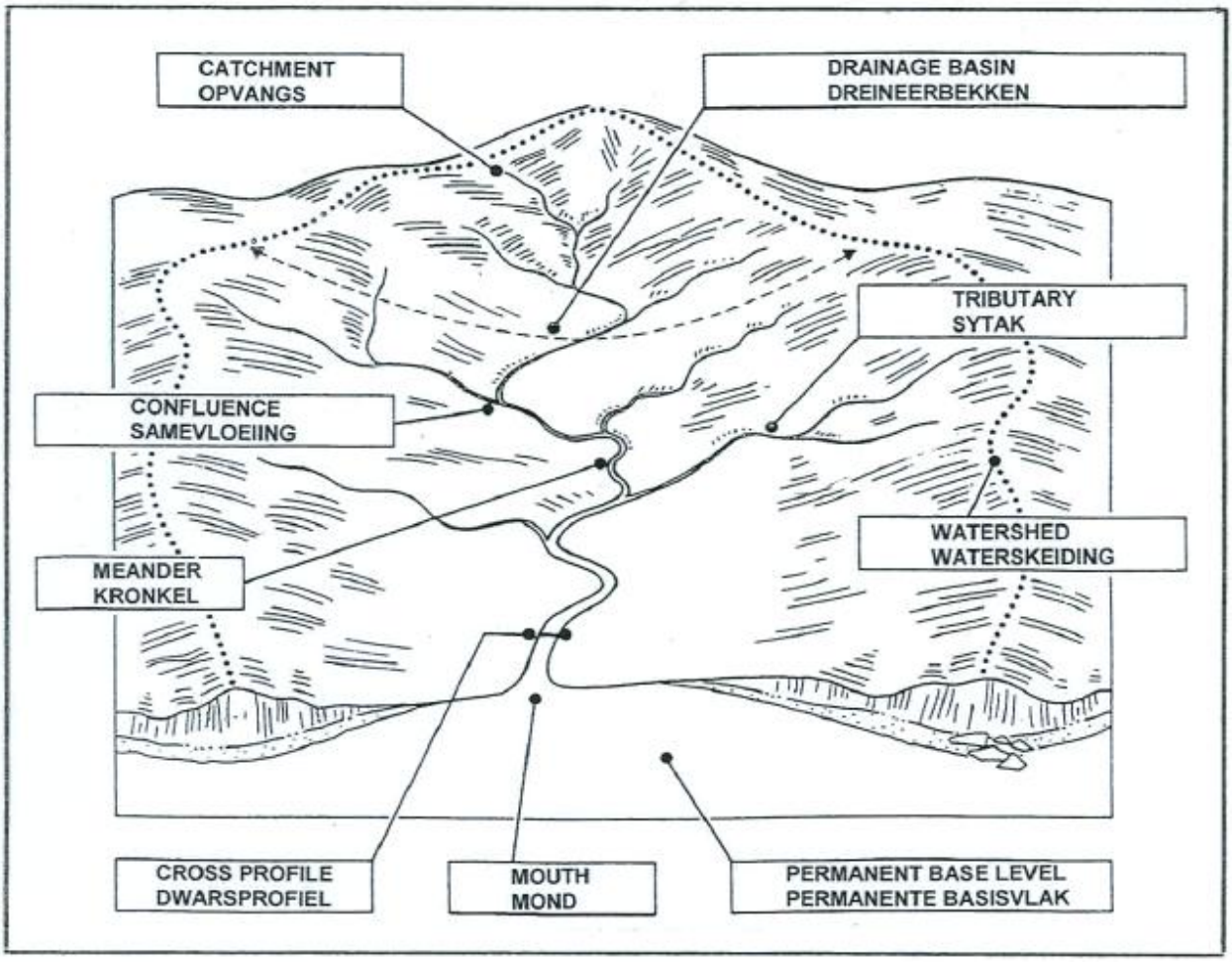
[22]

HINTS

Hint 1 – Analyse the resource material carefully. Some of the answers come straight out of the resources material.

QUESTION 3: 5 minutes 10 marks *(Source: DoE: Nov. 2008)*

3. Use the figure below which shows the different fluvial processes and characteristics of a drainage basin to assist you to give ONE term for each of the descriptions below. Write only the term next to the question number as an answer, for example 3.6 base flow.



3.1 Area where a river gets its water from
3.2 Area drained by a river and its tributaries
3.3 The point where a tributary meets the main stream
3.4 Section of a stream from one bank to the other
3.5 High-lying area that separates two drainage basins (5 x 2) [10]

QUESTION 4: 20 minutes 28 marks *(Source: DoE Nov. 2008)*

4. FIGURE 4 A illustrates a drainage basin. FIGURE 4 B shows the three river courses associated with a river system. Examine both diagrams carefully.

Figure 4 A

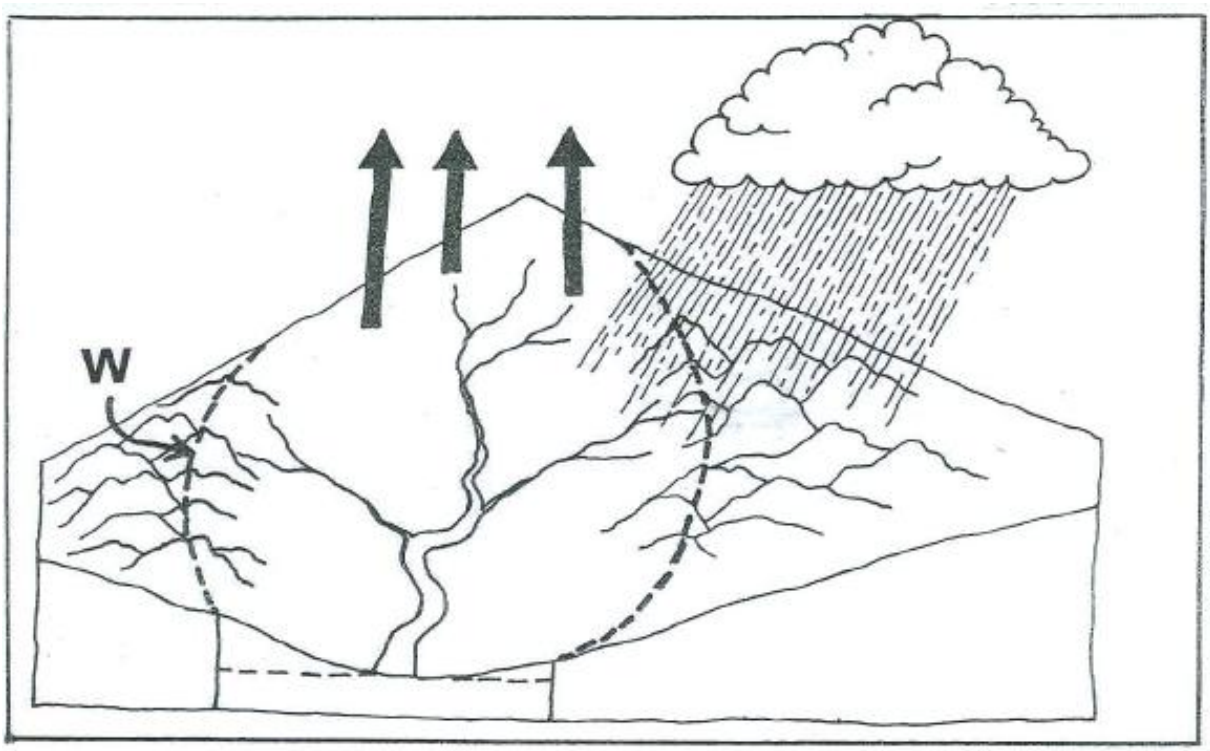
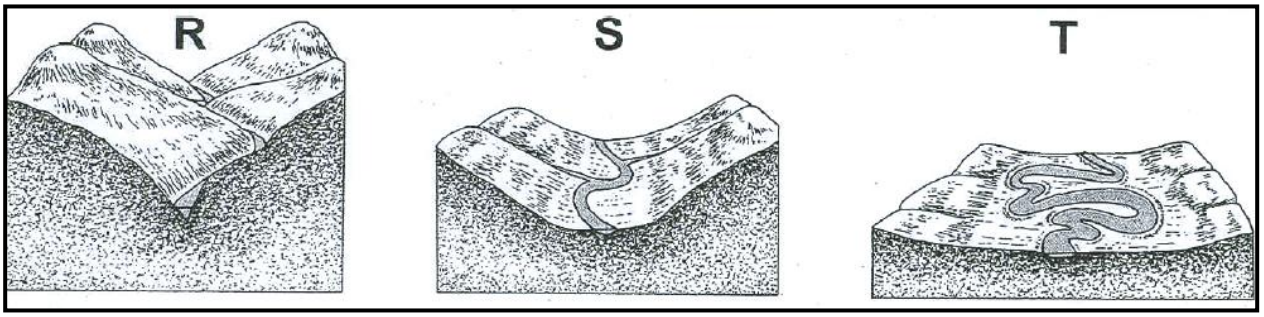


Figure 4 B



4.1 (a) The drainage basin illustrated in FIGURE 4A shows a *low drainage density (coarse texture)*. What does this mean? (1 x 2) (2)

(b) Give TWO possible reasons why this drainage basin has a low drainage density (coarse texture). (2 x 2) (4)

(c) Explain why the two factors mentioned in QUESTION 4.1(b) will result in a low drainage density (coarse texture). (2 x 2) (4)

4.2 (a) Identify the THREE main river courses labelled **R**, **S** and **T** in FIGURE 4 B respectively. (3 x 2) (6)

(b) Along which ONE of the three courses labelled **R**, **S** or **T** will flooding most likely occur? (1 x 2) (2)

(c) Explain how the characteristics of the river course mentioned in QUESTION 4.2(b) will promote flooding here. (2 x 2) (4)

(d) Flooding along the river course named in QUESTION 4.2(b) can be both a blessing and a curse for the people living on the adjacent flood plain. Explain this statement. (2 x 2) (4)

(e) State ONE method that can be introduced to reduce flooding along the river course named in QUESTION 4.2(b). (1 x 2) (2)

[28]

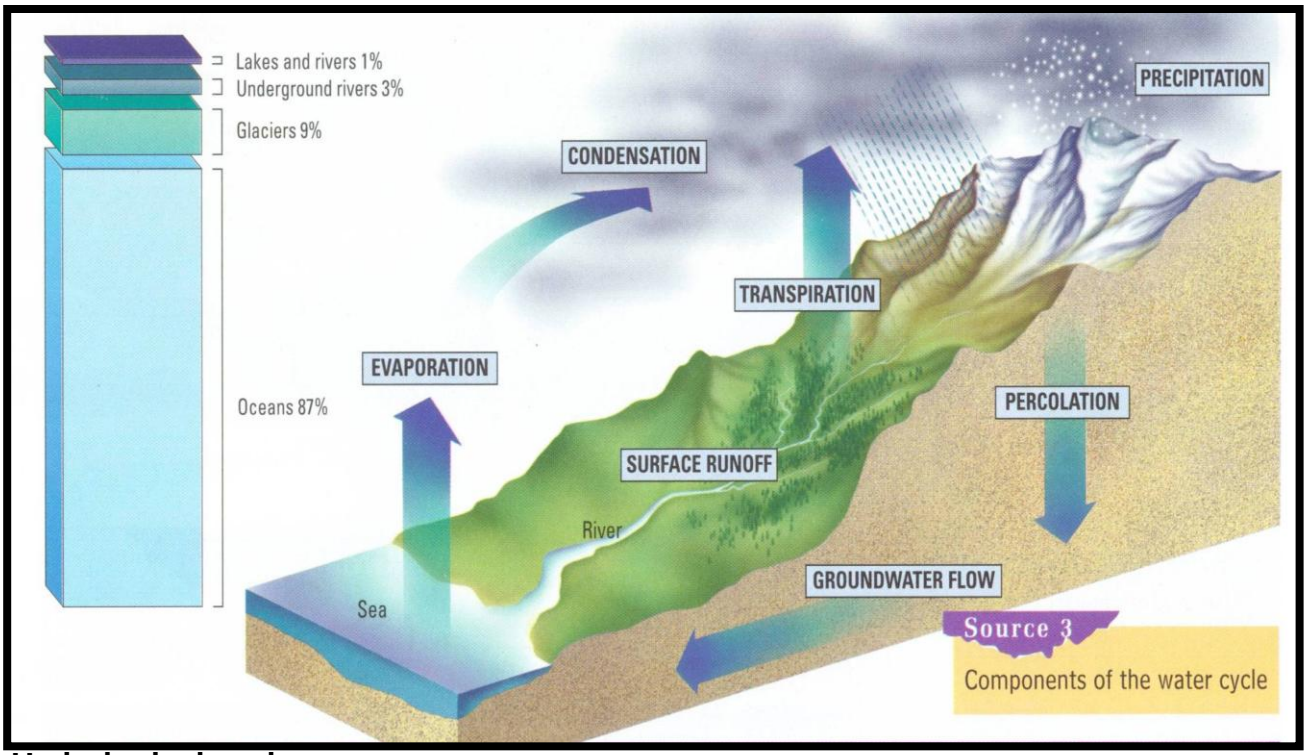
SECTION B: ADDITIONAL CONTENT NOTES

INTRODUCTION

Geomorphology is the study of landforms and the forces that formed them.

1. Where does the water in rivers come from?

- Surface run-off / Direct run-off:
  Sheet flow and stream flow after precipitation. (Meteoric water)
- Ground water / Base flow:
  Infiltrated water that is first stored as ground water and later seeps into streams. This is supplemented with juvenile water and fossil water in some regions.



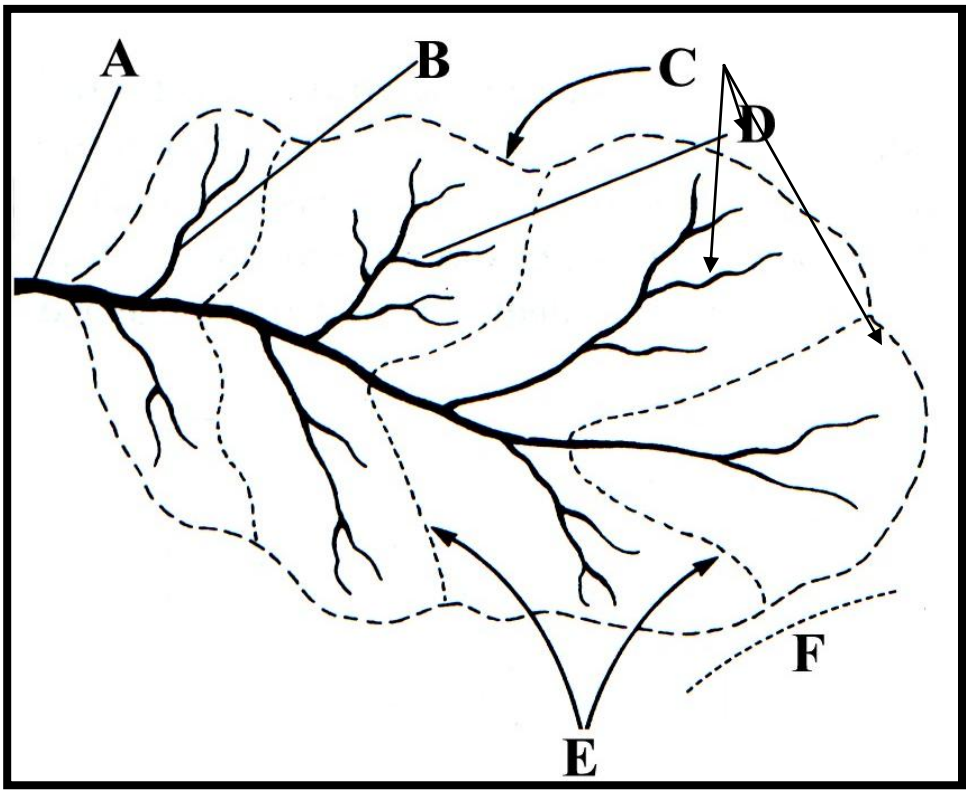
Hydrological cycle

2. Factors influencing run-off, infiltration (and rate of erosion)

- Precipitation: Soft – more infiltration, Hard – less infiltration.
  Winter rain – less evaporation – more infiltration, summer rain – more evaporation less infiltration.
- Soil moisture content: If soil is already saturated with water there will be little infiltration and more run-off.
- Vegetation: Dense vegetation enhances infiltration, while sparse vegetation leads to more run-off and less infiltration.
- Gradient of the slope: Steep slopes lead to more run-off, and gradual slopes enhance infiltration.
- Porosity: Porous rock allows more infiltration and reduces the run-off in the area.
- Permeability: Rock with joints and cracks allows more infiltration.

3. Drainage basins (terms you should know):

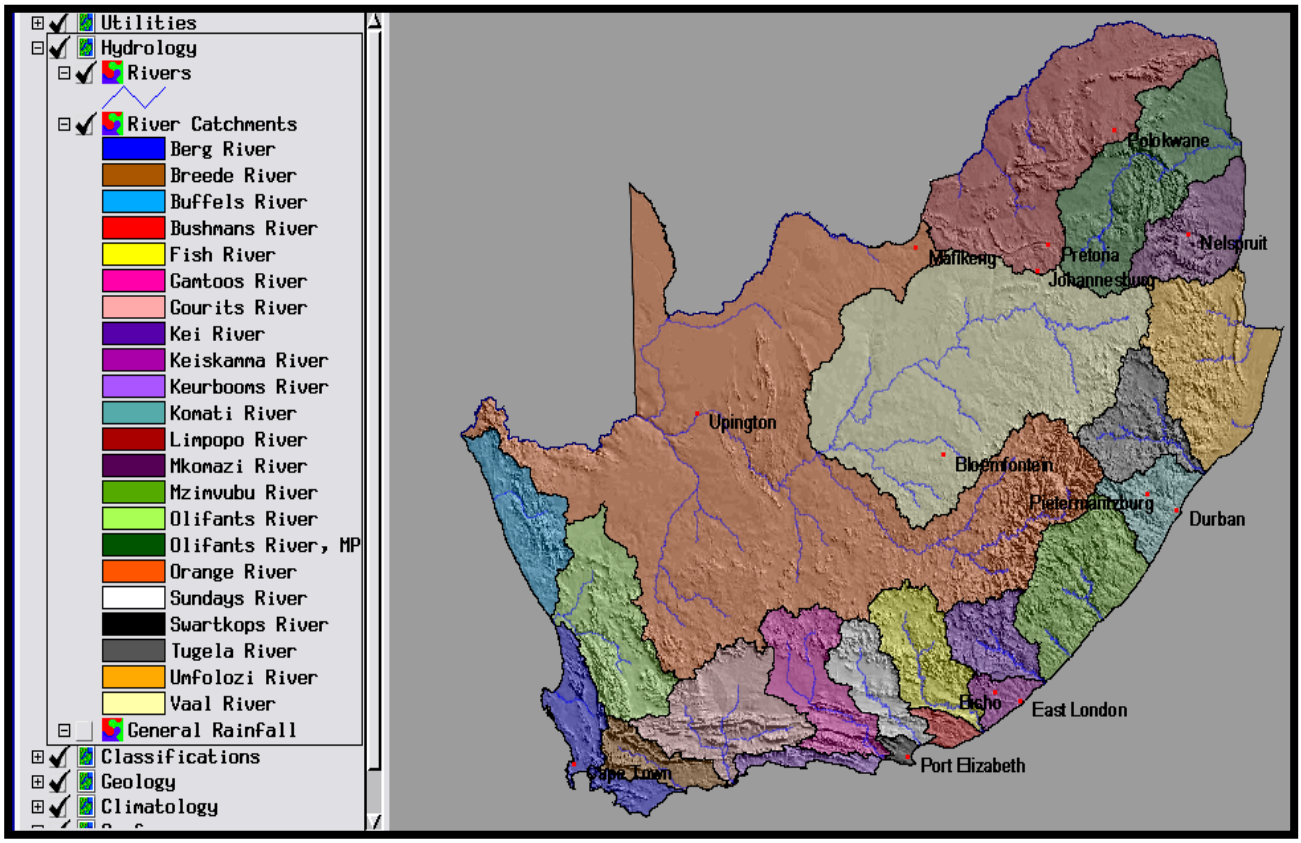
- River system: main stream and all its tributaries.
- Drainage basin / Catchment area:
  The whole area drained by a river system. Area from where stream gets water.
- Watershed: The high lying areas that separate different drainage basins.
- Interfluves: Spurs that separate different tributaries in a river system.
- Tributary: Smaller stream that joins main stream.
- Confluence: Where 2 tributaries meet.



River systems

A: Main stream / Mouth
B: Tributary
C: Watershed
D: Origin of stream
E: Interfluves
F: Main watershed

Drainage basin of South Africa



Source: Geomatica Titanium – South Africa, Hydrology

3.1. Characteristic of a drainage basin

3.1.1 Stream order:

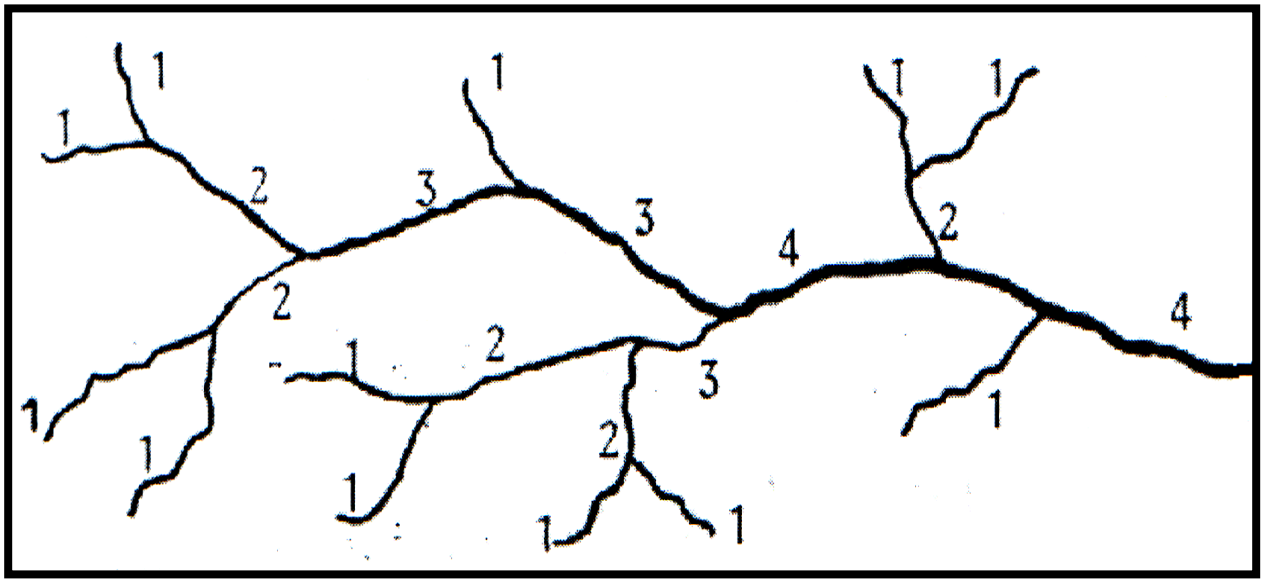
All origin streams are order 1, where 2 similar order streams meet, it goes to the next order, e.g. 3 meets 3 = 4

- The higher the order, the less of those streams that would be in a drainage basin.
- Higher order streams are longer than low order streams.
- Low order streams have steeper gradients than high order streams.
- Higher order streams drain larger areas of the total drainage basin.

A second order stream occurs where 2 first order streams join. It remains a second order stream when another first order stream joins. It only becomes a third order stream when 2 second order streams join. Label the second order stream on the map below.

The order of the stream increases when 2 same order streams meet.

Redraw this and make all the different order streams different colours.



3.1.2. Drainage density:

The total length of all streams in a drainage basin:
Fine – many streams / area
Medium – average amount of streams
Course – few streams / area

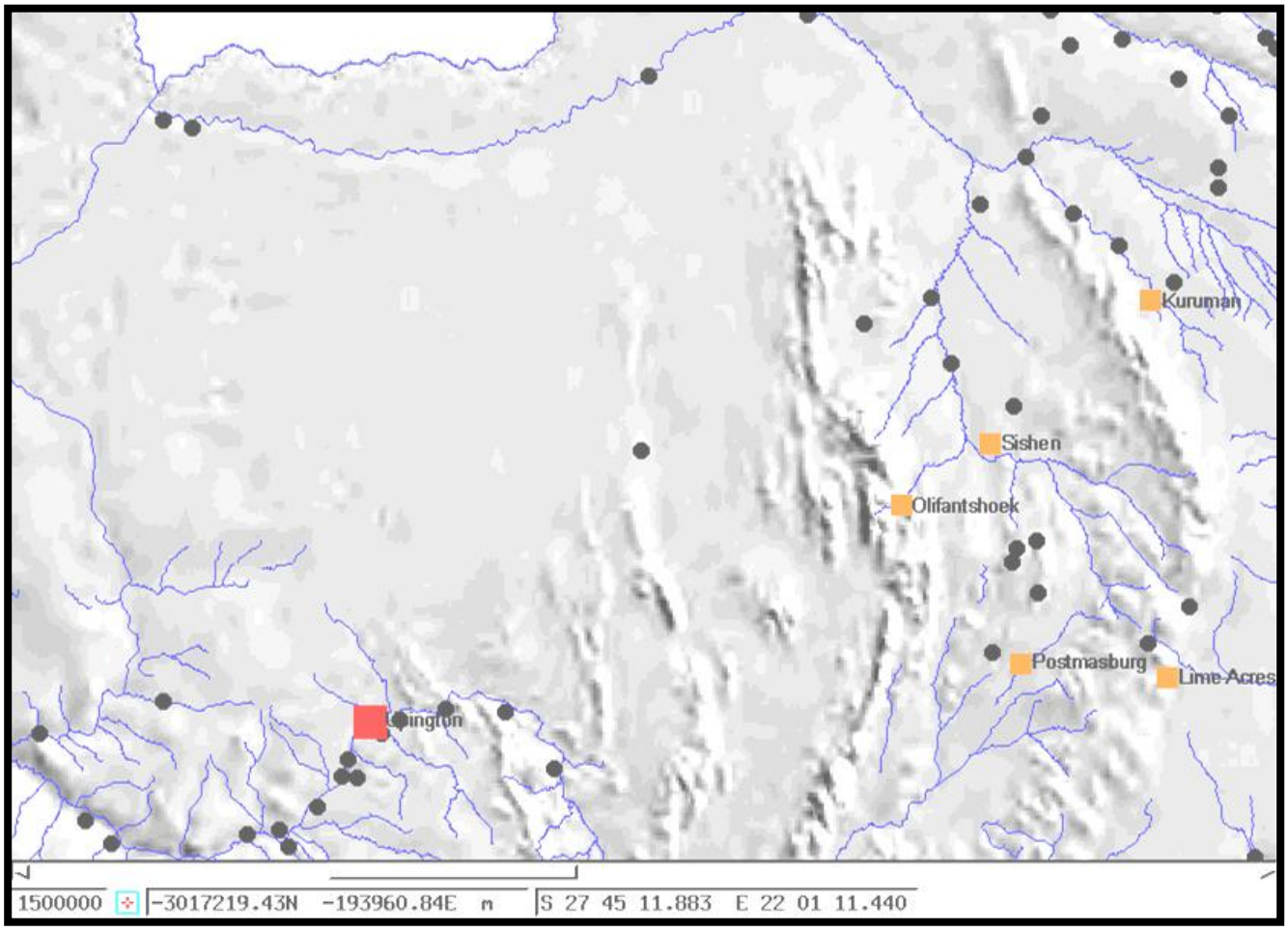
Factors influencing drainage density:

- Precipitation: More precipitation will lead to more streams on the surface.
- Gradient: Steeper gradients cause faster run-off and less surface streams.
- Vegetation: Dense vegetation causes more infiltration and thus less surface streams.
- Permeability and porosity: Rock that is porous and permeable will allow more infiltration, and less surface streams will develop

The 2 maps below illustrate different drainage densities in South Africa. The first map is of an area next to the Orange River in the Northern Cape, where the rainfall is low, the vegetation is sparse, the infiltration and evaporation is high, and the area is very gradual. Here the drainage density is very low.

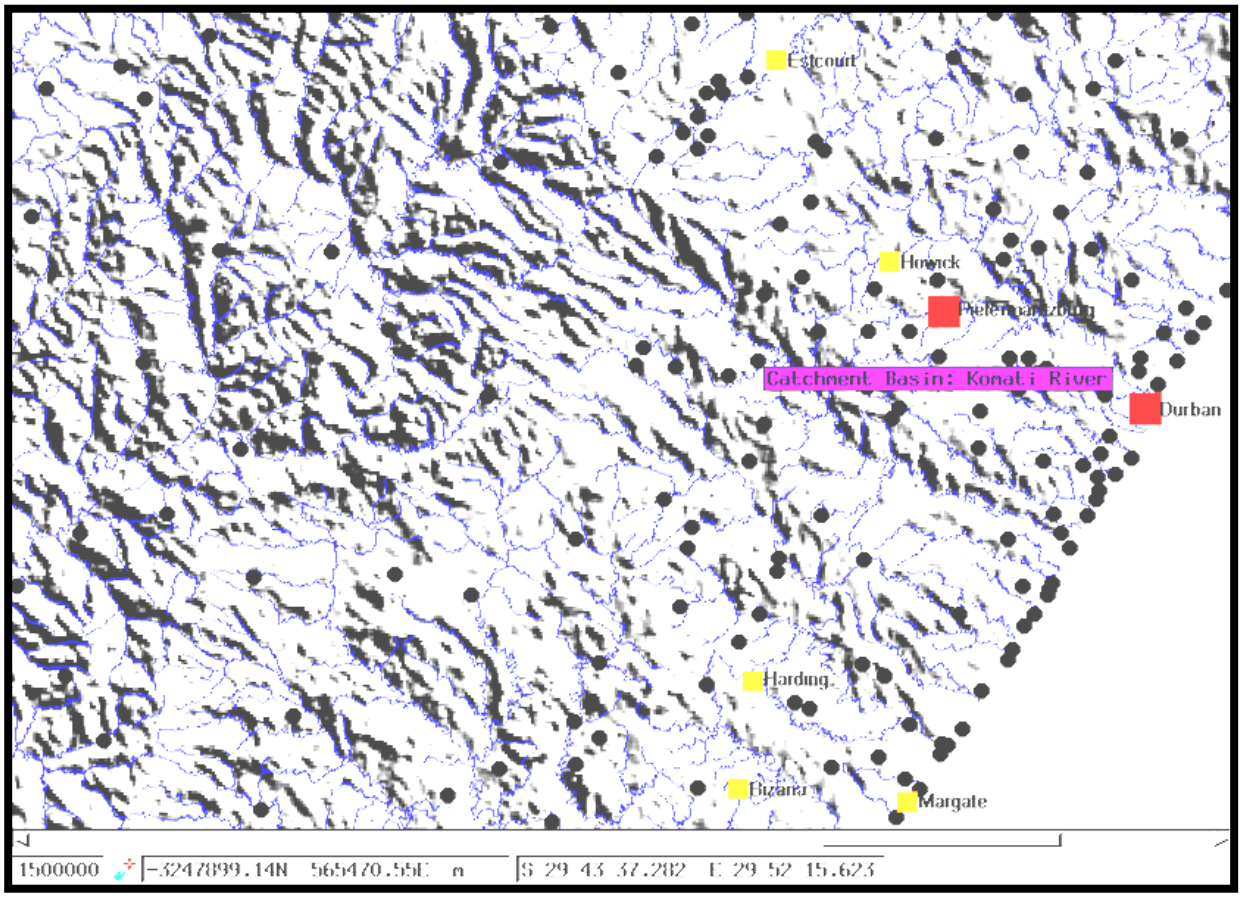
The second map covers an area in KwaZulu-Natal near Durban. The rainfall is high, the vegetation is abundant, the slope is steep and the water table is high.

Low drainage density near Olifantshoek, Sishen and Kuruman



Source: Geomatica Titanium – South Africa, Hydrology

High drainage density east of Durban

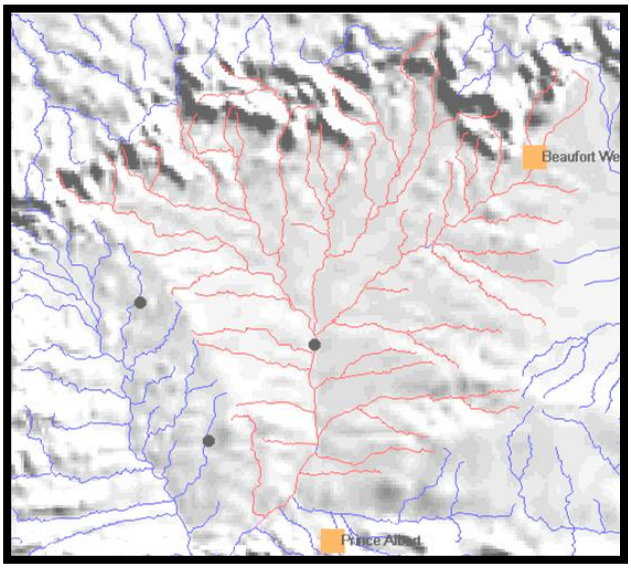


Source: Geomatica Titanium – South Africa, Hydrology

3.1.3. Drainage patterns

Drainage pattern refers to the shape of the river system caused by the underlying rock.

A. Dendritic: tree shape, develops on uniform rock. Tributaries join at more obtuse angles on steeper slopes.

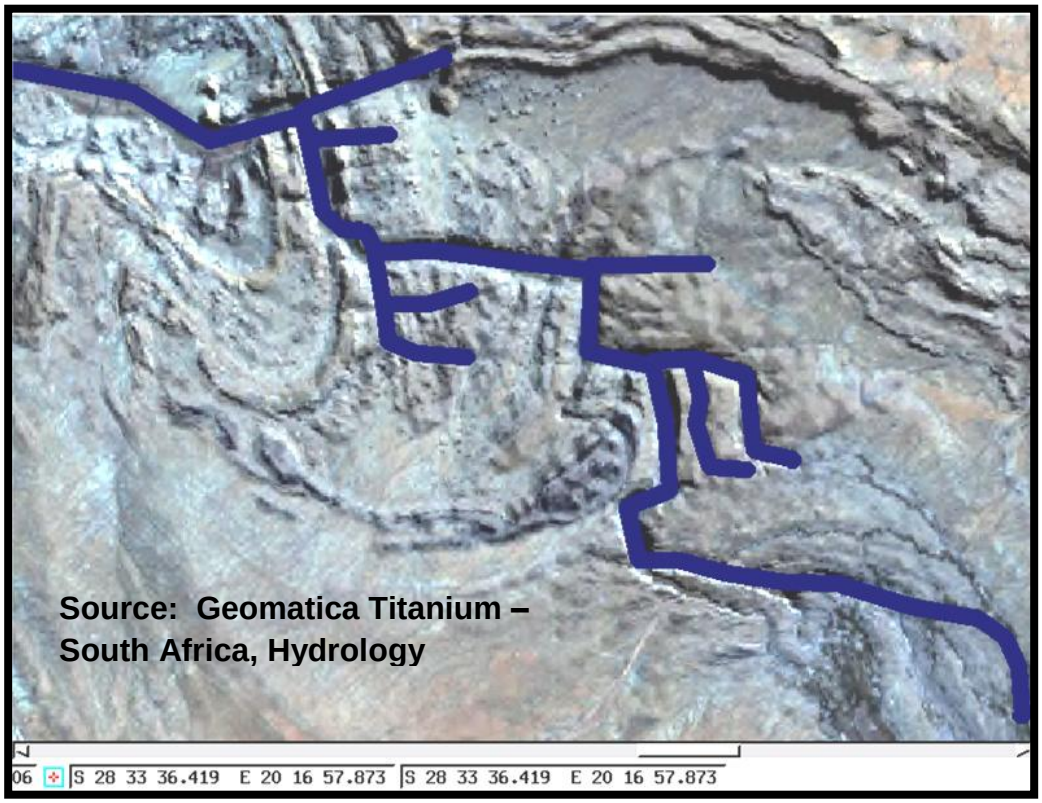


A Dendritic drainage pattern in the Karoo
These are tributaries in the upper reaches of the Gouritz River.

Source: Geomatica Titanium – South Africa,| Hydrology

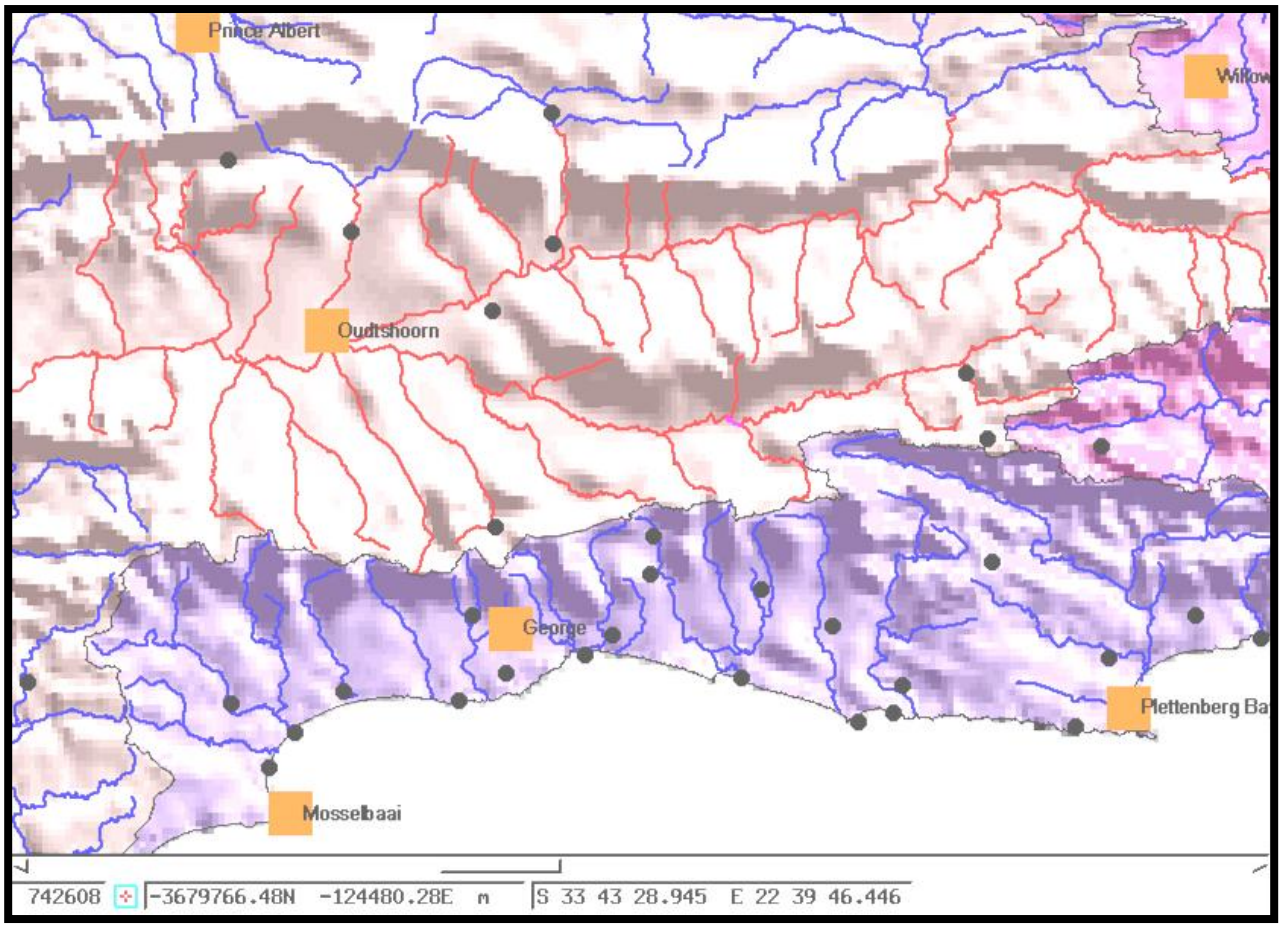
B. Rectangular: main stream and tributaries has 90º angles in, develop on jointed rock.

Rectangular pattern along the Orange River over jointed rock



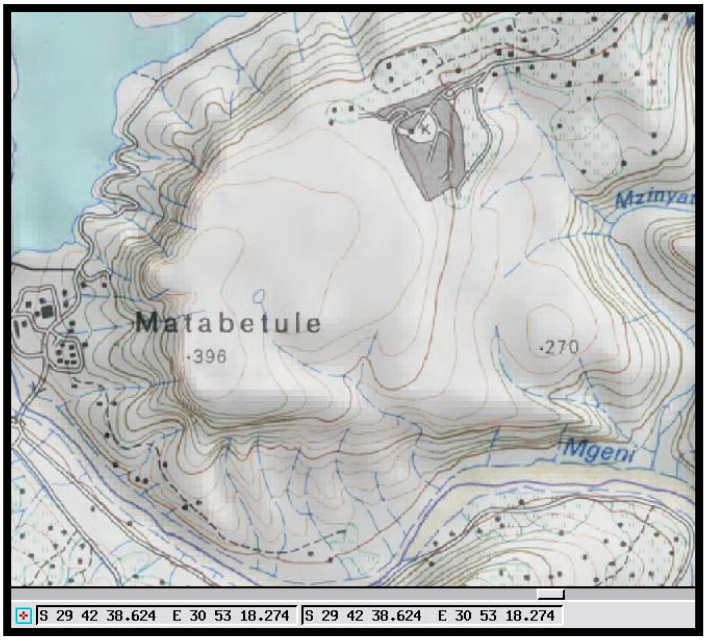
C. Trellis: Parallel main streams with short tributaries that join the main stream at right angles. Develop in fold mountains, homoclinal ridges or alternating soft and hard rock.

A trellis pattern in another part of the Gouritz catchment area in the Oudtshoorn area is between the Cape fold mountains.



Source: Geomatica Titanium – South Africa, Hydrology

D. Radial / Centrifugal: All streams run outwards from a single high point, e.g. islands, mesas, conical hills and buttes.



Small first order streams run in all directions from the Matabetule mesa (table mountain)

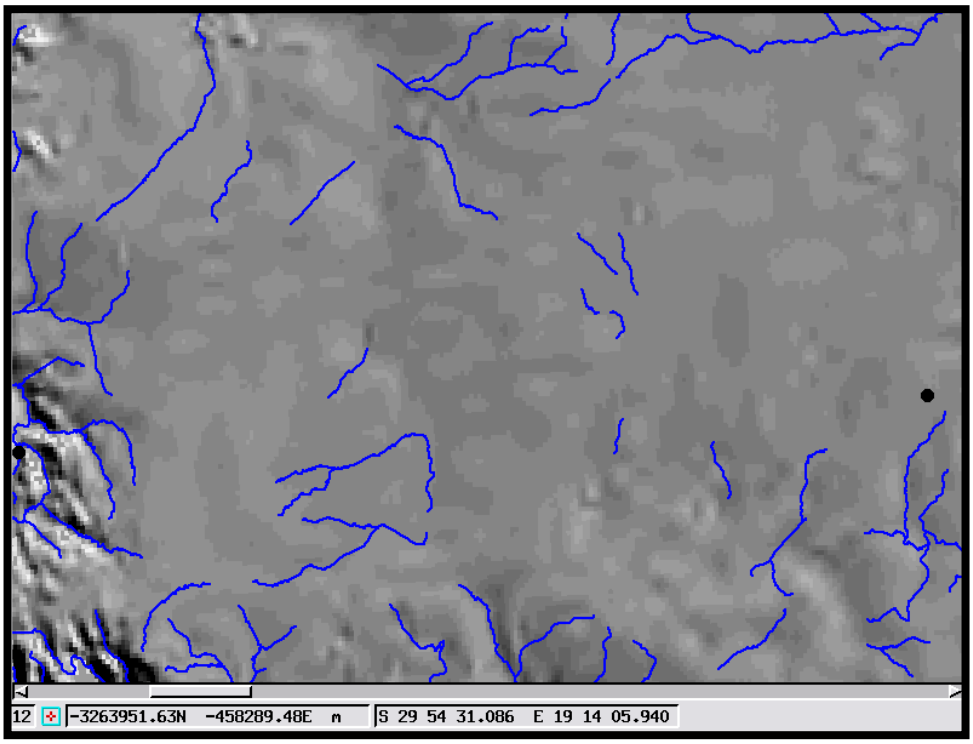
Source: Geomatica Titanium – Durban local level

E. Centripetal: All streams run to one central lake, e.g. inside a volcanic crater.

A centripetal drainage pattern around the Inanda dam

Source: Geomatica Titanium – Durban local level.

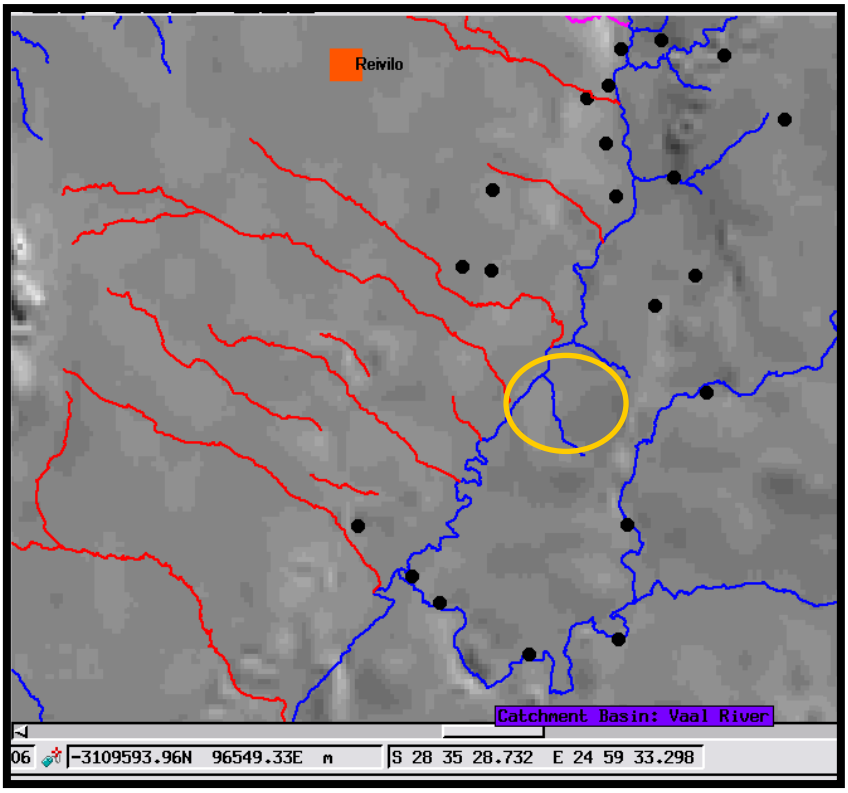
F. Deranged: No clear pattern visible. Develops on very flat areas or areas that had a continental glacier on them. Many lakes and marshes.



A Deranged drainage stream pattern near Springbok in the Northern Cape
There is no clear pattern and streams do not link up or flow in a specific direction.

Source: Geomatica Titanium – South Africa, Hydrology

G. Parallel: Develop on steep slopes – streams run straight down.



The red lines indicate Parallel streams in the Northern Cape.

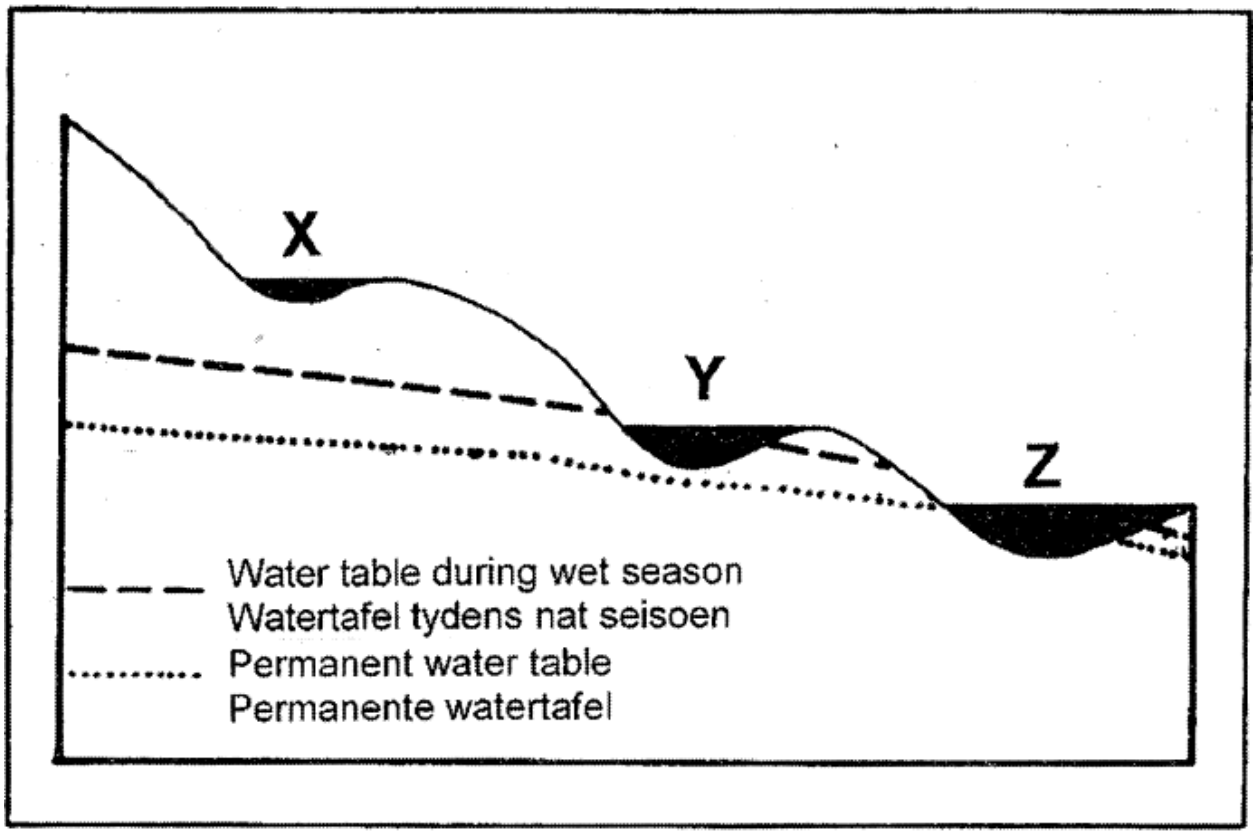
The yellow circle on the map illustrates a river that joins the mainstream at an awkward angle. This is a barbed stream pattern

Source: Geomatica Titanium – South Africa, hydrology

H. Barbed: Tributary seems to join from downstream.

SECTION C: HOMEWORK

QUESTION 1: **5 minutes** **10 marks** *(Source: DoE March 2010)*



1. Refer to the figure above illustrating the relationship between stream type and the water table.

   Indicate whether the following statements are TRUE or FALSE. Write only 'true' or 'false' next to the question number.

   1.1 River X will only flow after a heavy thunderstorm.

   1.2 River Y is a periodic river.

   1.3 River Z will only flow during the wet season.

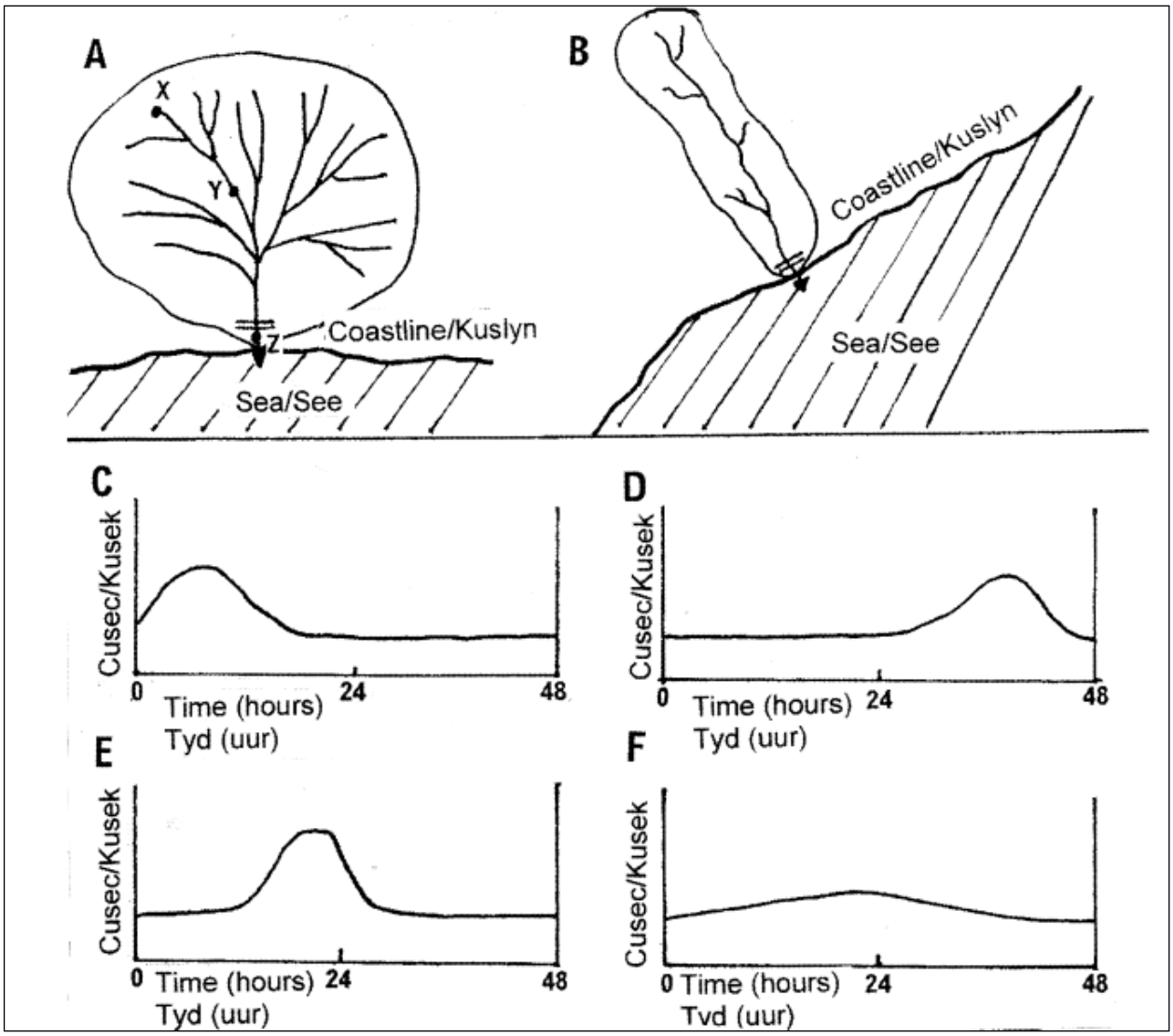
   1.4 The water table lies at a lower level during a prolonged drought.

   1.5 River Z does not receive any water from base flow to support its flow.

   (5 x 2) [10]

QUESTION 2: **20 minutes** **20 marks** *(Source: DoE March 2010)*

Refer to FIGURE 2.4 (A – F) representing the drainage basins of two river systems (A and B) and flow hydrographs (C – F) to show run-off in rivers after rain showers. Also read the extract on floods below.



Flooding occurs when water overflows its normal channels such as streams and storm water drains. Floods may also occur when there is an accumulation of water by drainage into areas which are not normally submerged. Floods are common in South Africa following long periods of drought. Drought, overgrazing and the deterioration of the land make the ecosystem vulnerable. Humans can alter the flow characteristics of a river negatively by clearing vegetation, constructing impermeable tar and concrete surfaces, and building on a river's flood plain.

2.1. Define the following terms referred to above:

(a) Drainage basin (1 x 2) (2)

(b) River system (1 x 2) (2)

2.2 Describe the shapes of drainage basins A and B respectively. (2 x 2) (4)

2.3 List and explain any TWO factors that could influence the run-off in a river. (4 x 2) (8)

2.4 Suppose a rain shower of 100 mm occurs in each of drainage basins A and B. Which of the flow hydrographs (C – F) will most likely represent stream flow at the point marked = in drainage basins A and B respectively? (2 x 2) (4)

[20]

SECTION D: SOLUTIONS AND HINTS TO SECTION A

QUESTION 1

1.1.1. False✓✓

1.1.2. True✓✓

1.1.3. True✓✓

1.1.4. False✓✓

1.1.5. False✓✓ (5 x 2) **[10]**

QUESTION 2

2.1 (a) Dendritic ✓✓ (1 x 2) (2)

(b) It looks like the branches of a tree ✓✓
Tributaries join the main stream at acute/small angles ✓✓
[Any ONE] (1 x 2) (2)

2.2 (a) Situation that develops when a river overflows its banks and covers areas with water that are usually not covered by water ✓✓
[Concept] (1x2) (2)

(b) Shortage of space for development ✓✓
Attachment that they have developed with the area over time ✓✓
[Any ONE] (1 x 2) (2)

(c) The land is covered by artificial surfaces ✓✓
Water does not infiltrate the surface ✓✓
More water reaches the stream; therefore, flood peak is higher ✓✓
Water flows faster on artificial surfaces thus lag time shortened ✓✓
[Any THREE] (3 x 2) (6)

(d) Destruction of infrastructure ✓✓
Loss of life ✓✓
Houses washed away/damaged ✓✓
Personal belongings washed away/damaged ✓✓
Costs involved to rebuild ✓✓
[Any TWO] (2 x 2) (4)

2.3 (a) Sewerage works are located on river banks ✓✓ (1 x 2) (2)

(b) Contamination of water ✓✓
Eutrophication ✓✓
Permanent stunch ✓✓
Diseases ✓✓
Dam becomes unsightly ✓✓
Drop in land value next to the dam ✓✓
[Any TWO] (2 x 2) (4)

(c) Bilding purification dams ✓✓
Relocate the sewerage works ✓✓
Legislation preventing raw sewerage being dumped into rivers ✓✓ [Any TWO] (2 x 2) (4)
[28]

QUESTION 3

3.1. Catchment area ✓✓
3.2 Drainage basin ✓✓
3.3 Confluence ✓✓
3.4 Cross profile ✓✓
3.5 Watershed ✓✓ (5 x 2) **[10]**

QUESTION 4:

4.1 (a) Total length of streams is small in relation to the size of the drainage basin ✓✓ [Concept] (1 x 2) (2)

(b) Low rainfall ✓✓
Soft soaking rain ✓✓
Dry soils ✓✓
Dense vegetation ✓✓
Permeable rock ✓✓
High infiltration rate ✓✓
Gentle gradient ✓✓
Resistant rock ✓✓
High evaporation rate ✓✓ [Any TWO] (2 x 2) (4)

(c) Low rainfall: little surface water to form run-off ✓✓
Soft soaking rain: water infiltrates thus little surface water ✓✓
Dry soils: absorbs water thus little surface water ✓✓
Dense vegetation: retards flow of water resulting in infiltration thus little surface water ✓✓
Permeable rock: allows infiltration thus little surface water ✓✓
High infitration rate: reduces surface run-off ✓✓
Gentle gradient: slows down flow resulting in infiltration thus little surface water ✓✓
Rock resistance: the more resistant the rock the fewer streams will be carved ✓✓
High evaporation: less water available to form run-off ✓✓
[Any TWO. Must refer to answer in QUESTION 4.1(b)] (2 x 2) (4)

4.2 (a) R - Upper/torrent/youthful course ✓✓
S - Middle/valley/mature course ✓✓
T - Lower/plain/old age course ✓✓ (3 x 2) (6)

(b) T/lower or plain course ✓✓ (1 x 2) (2)

(c) Gentle gradient slows down velocity and water spills over banks ✓✓
Wide, gentle flood plain allows water to spread easily ✓✓
Large volume of water from tributaries upstream ✓✓
Deposition of sediments make river shallower ✓✓
Meander necks are breached to cause floods ✓✓ [Any TWO] (2 x 2) (4)

(d) Flooding can cause damage ✓✓
Flooding provides fertile silt that is deposited on the flood plain ✓✓
[Any ONE positive and any ONE negative effect] (2 x 2) (4)

(e) Small catchment dams in upper course to release water at intervals into the main stream ✓✓
Large flood control dams in lower reaches ✓✓
Raise river banks (levees) artificially ✓✓
Line rivers with cement to reduce friction and increase velocity ✓✓
Increase gradient by cutting through meander necks to increase velocity✓✓
Increase vegetation/prevent deforestation ✓✓ [Any ONE] (1 x 2) (2)

[28]

TOPIC 2: RIVER CAPTURE AND RIVER PROFILES

Learner Note: This section with diagrams and examples of the river capture or profiles of rivers is always asked in the exam. This can be integrated with topic 1 and asked in combinations.

SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: **20 minutes** **24 marks** *(Source: DoE November 2008)*

Imagine that you are sailing by boat from the source of the River Blea (K) to the mouth at J. Test your knowledge of fluvial processes and landforms by referring to FIGURES 1.A, 1.B and 1.C to answer the questions below.

1.1 Your sail down to the coast is smooth with no obstacles along the way. What type of profile does the River Blea have? (1 x 2) (2)

1.2 FIGURE 1.A shows a cross-section of a valley.

(a) Is the cross-section more likely to match the valley at point K or point J (FIGURE 1.B)? (1 x 2) (2)

(b) What is the main type of erosion in this valley and why is this so? (2 x 2) (4)

(c) The cross profile provides a geographer with two useful sources of information. Name the TWO sources. (2 x 2) (4)

1.2. Refer to FIGURE 1.C and meet Albert. Explain to Albert what has happened to the river, and why it seems to have moved. (Hint: Refer to meanders, erosion, deposition and ox-bow lakes.) (4 x 2) (8)

1.3. Pollution of the River Blea is a major problem. State TWO ways in which this will impact on the lives of the people. (2 x 2) (4)

[24]

Figure 1A

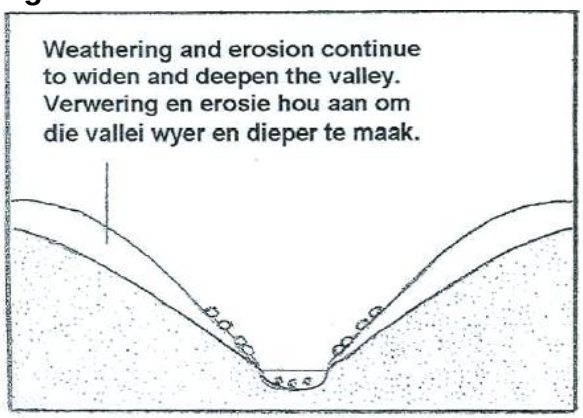


Figure 1B

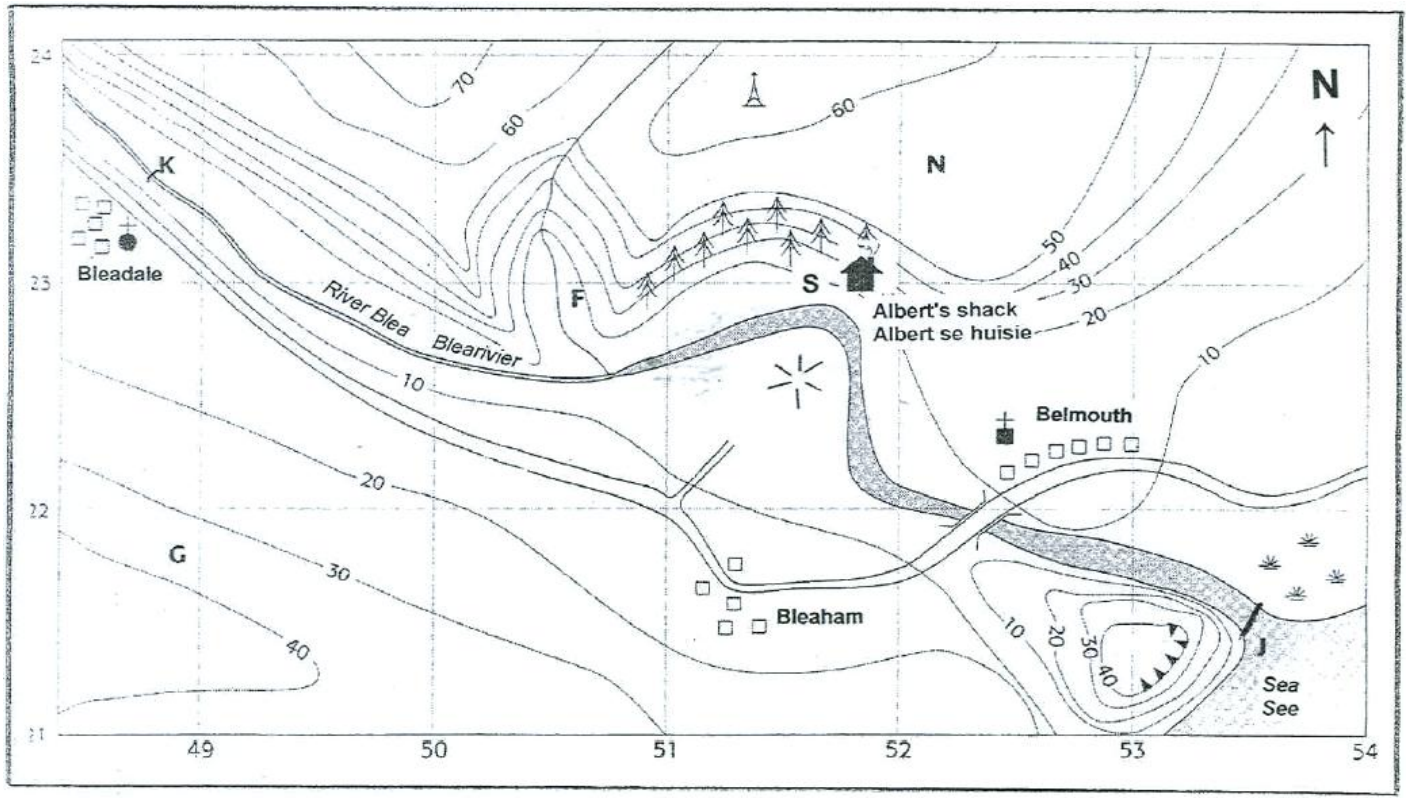
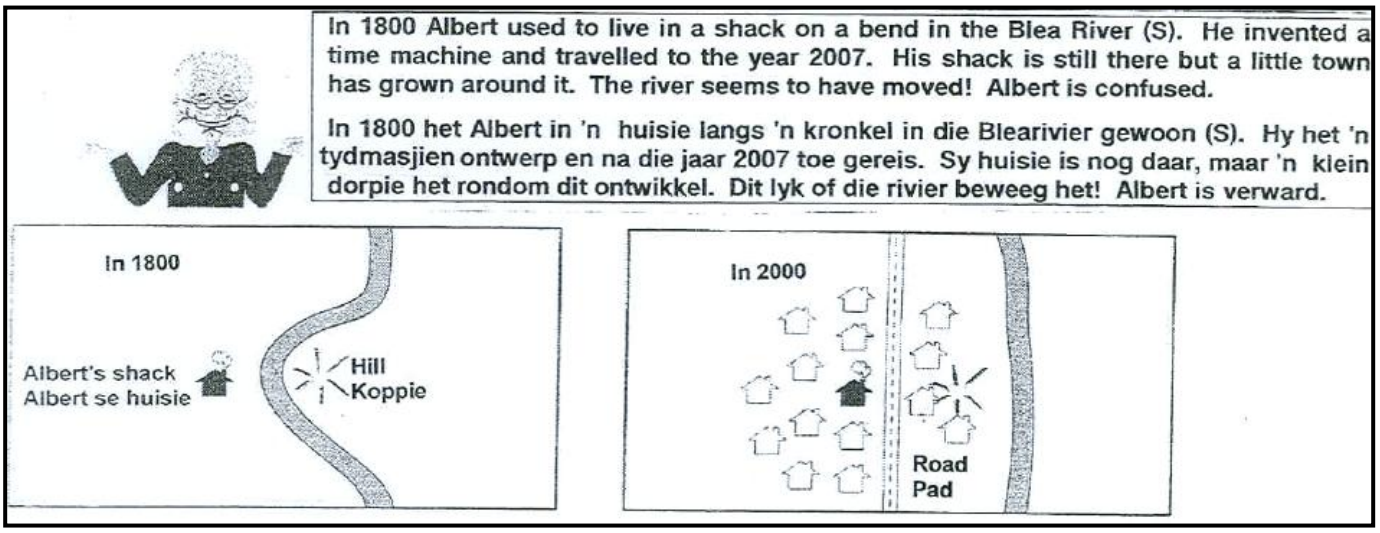


Figure 1C

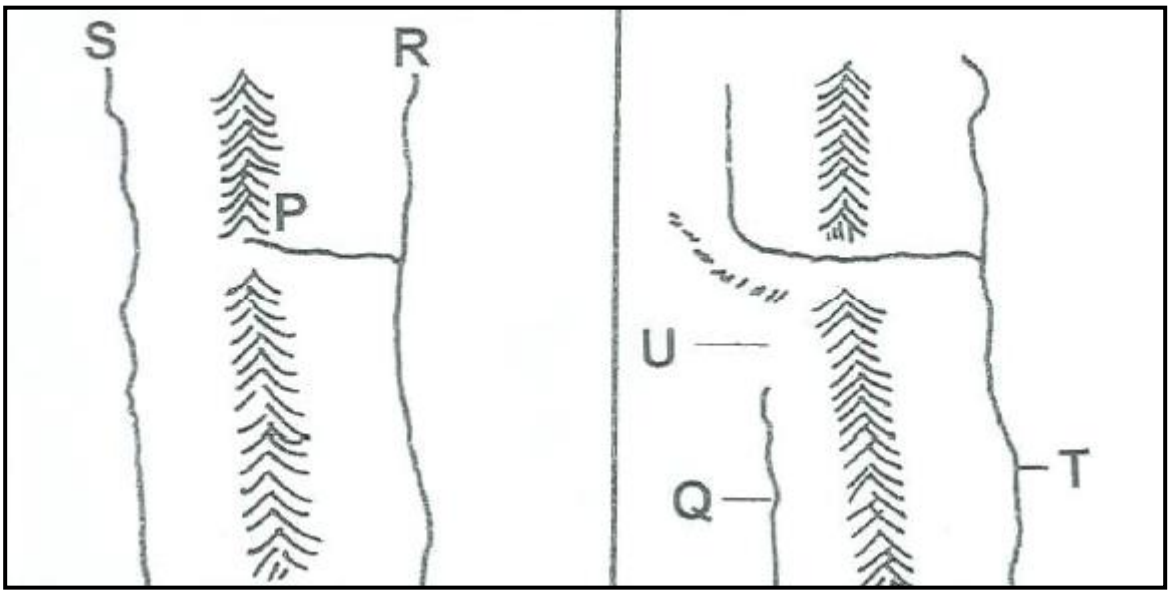


HINTS

Hint 1 – Carefully study the resource material as some of the answers can be extracted from there.

QUESTION 2: 5 minutes 10 marks *(Source: DoE November 2008)*

2. Refer to the figure below illustrating river capture (stream piracy). Choose the correct terms/letters from those given in brackets to make all the statements below TRUE. Write only the terms/letters next to the question number as an answer.



2.2.1 Stream (R/S) is situated higher above sea level.

2.2.2 (Headward/Lateral) erosion will take place at P.

2.2.3 Q is the (misfit/pirate) stream.

2.2.4 Rejuvenation will take place in river (Q/T).

2.2.5 Area U is known as the (wind gap/elbow of capture). (5 x 2) [10]

HINTS

Hint 1 – Stream piracy or river capture is often asked in the exam.

Hint 2 – You need to know the sketch and be able to identify the features that develop, and then describe the process and explain how river capture will change the erosive capacity of the rivers.

QUESTION 3: 20 minutes 24 marks *(Source: DoE March 2010)*

3. Refer to FIGURE 1.5A showing a longitudinal river profile after rejuvenation has occurred. FIGURE 1.5B shows the effects of rejuvenation along the lower course of a river. Meanders may have been present along the river course. These meanders would have formed on a floodplain. Once the river is rejuvenated, it will incise and the meanders will no longer be on a plain but in deep, steep-sided valleys.

3.1 Define the following terms indicated on FIGURE 1.5:

(a) Graded profile (1 x 2) (2)

(b) Base level (1 x 2) (2)

3.2 Draw a diagram similar to FIGURE 1.5 to show a graded longitudinal river profile. (1 x 2) (2)

3.3 Provide evidence, visible in FIGURE 1.5, that rejuvenation has occurred. (1 x 2) (2)

3.4 Provide possible reasons why rejuvenation has occurred in this landscape. (2 x 2) (4)

3.5 The local community has proposed the construction of a major dam in the river system shown in FIGURE 1.5. Write a short essay (no more than 12 lines) to outline the advantages and disadvantages of such a proposal. (6 x 2) (12)

[24]

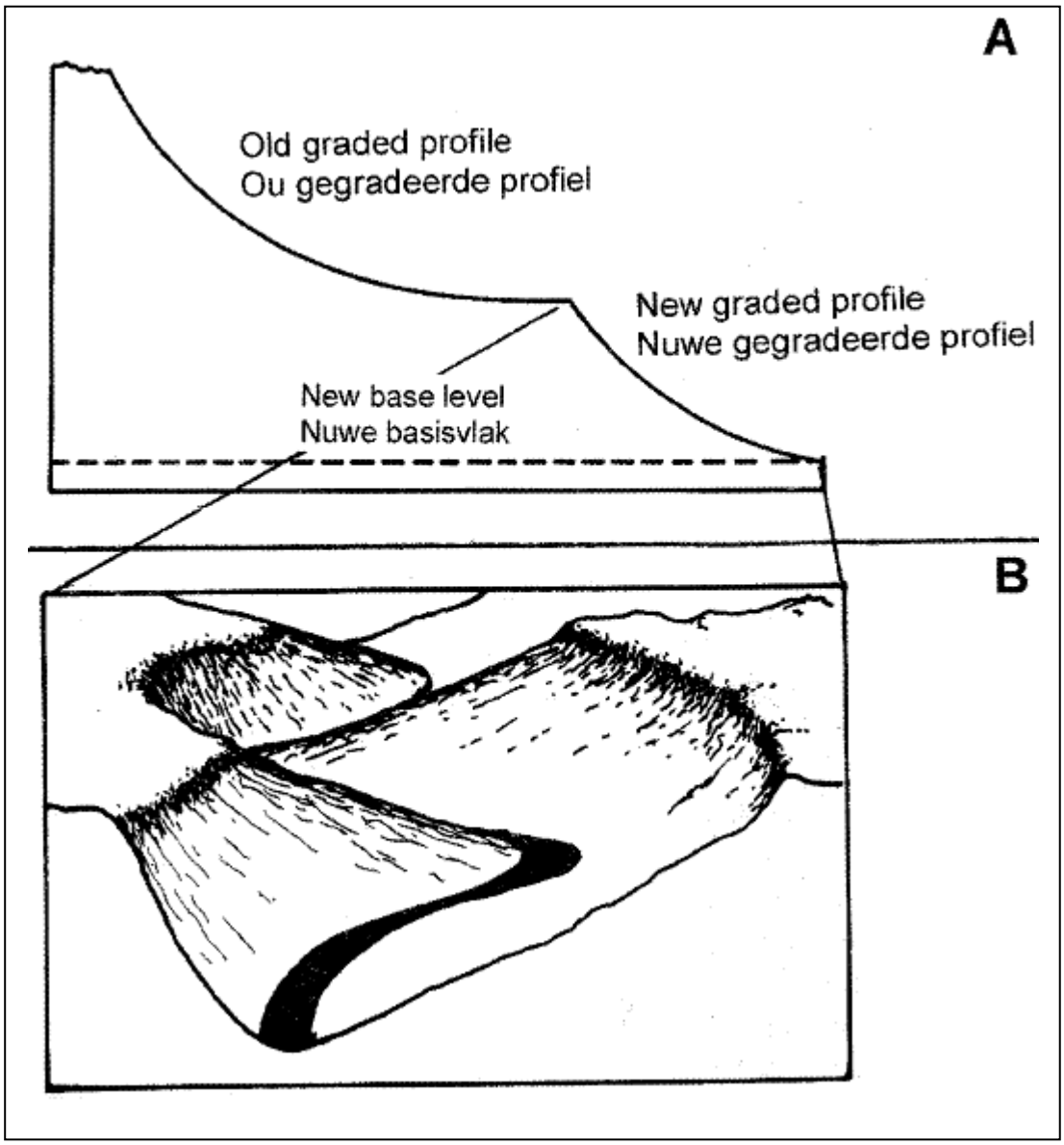


FIGURE 1.5

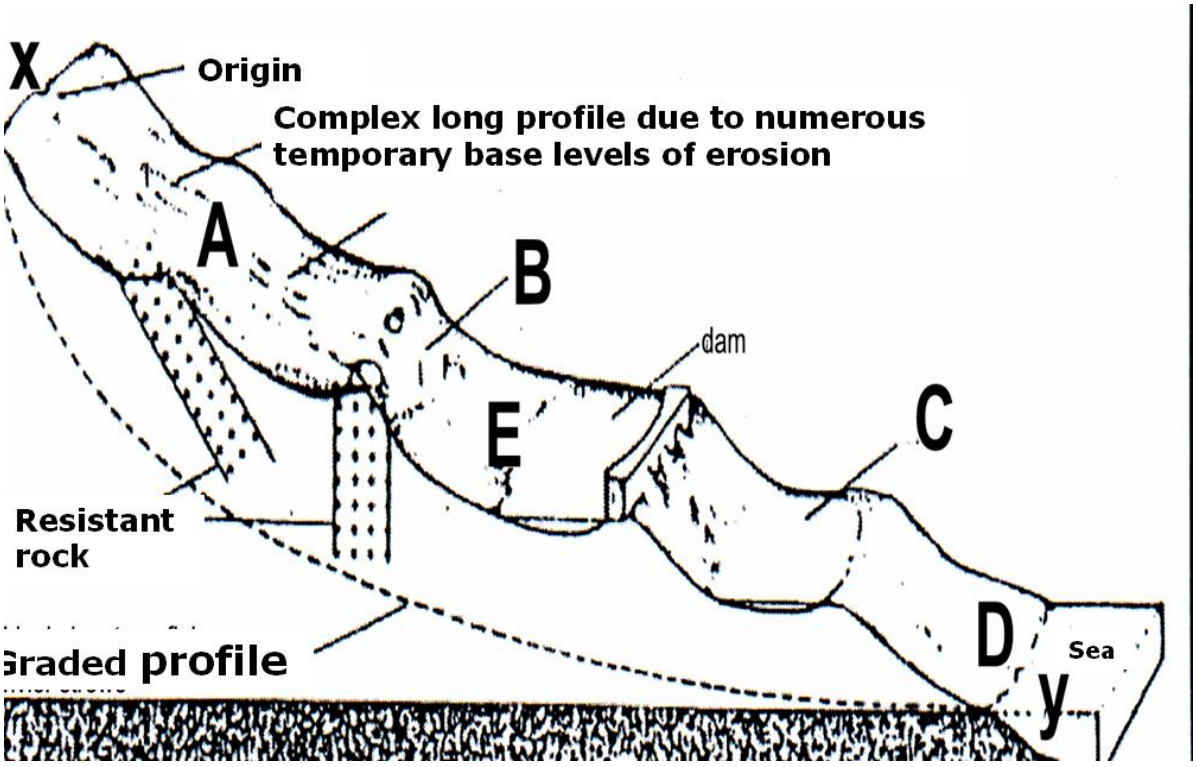
SECTION B: ADDITIONAL CONTENT NOTES

1. Stream Profiles

1.1. Longitudinal profile: (source to mouth)

- A river is graded if the long profile forms a perfect concave shape and no knick points occur along the long profile. There is a balance between the erosion and deposition in the river.
- The permanent base level of erosion is the lowest level to which a river can erode its valley – sea level.
- Temporary base levels of erosion slow down the erosion process above this point, e.g. dams, rapids, waterfalls, lakes or hard rock masses. Over time a river can erode it away.
- A river is ungraded if it has many knick points (temporary base levels of erosion) along the long profile.
- A knick point is a sudden change in the gradient of the stream, e.g. dams, lakes, waterfalls, rapids.
- Rejuvenation can cause the development of knick points along the long profile of a stream.

Most rivers are not graded but are working towards getting graded



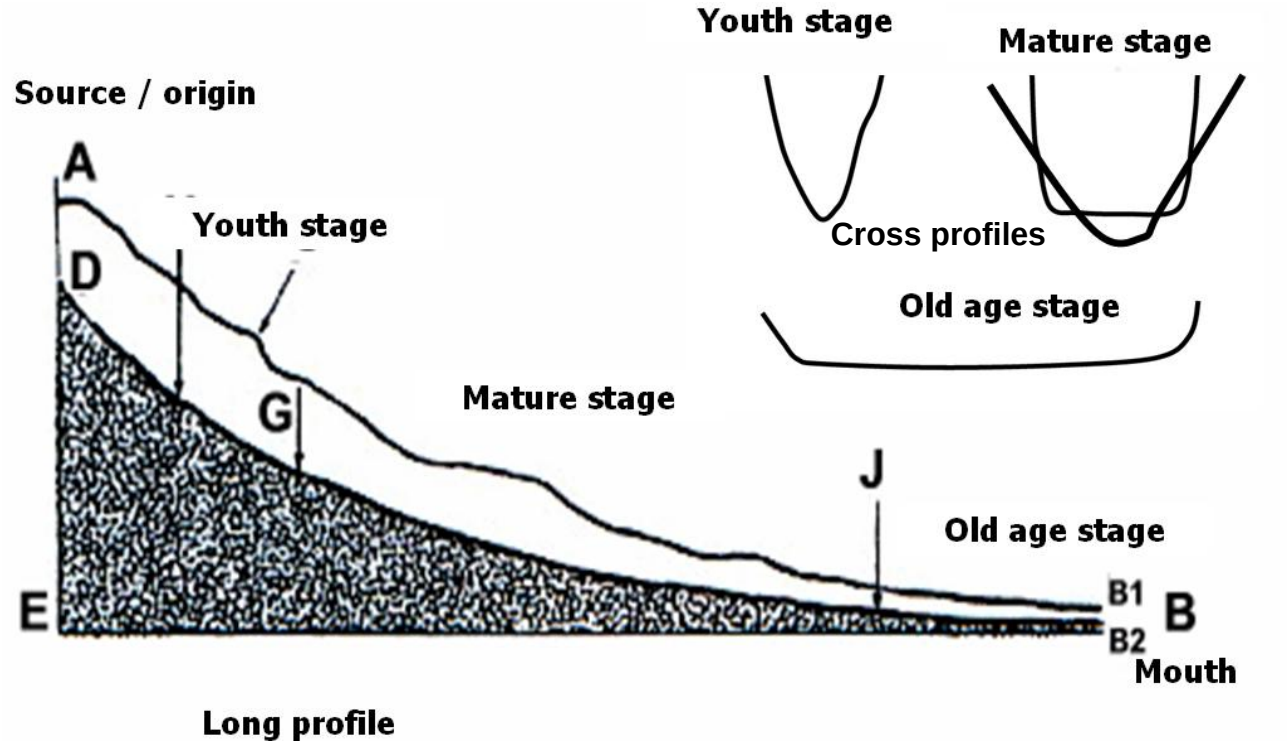
1.2. The cross / transverse profile of streams

- This is a cross section trough the river at the different stages of a river:
  1. Youth – small deep narrow v-shaped valley, where downward erosion is the most important process.

2. Mature – wider v-shaped valleys with spurs in between, where lateral erosion (undercutting of meanders) is the most important process.
3. Old age stage – wide open v-shaped valley or plain where deposition is the most important process.

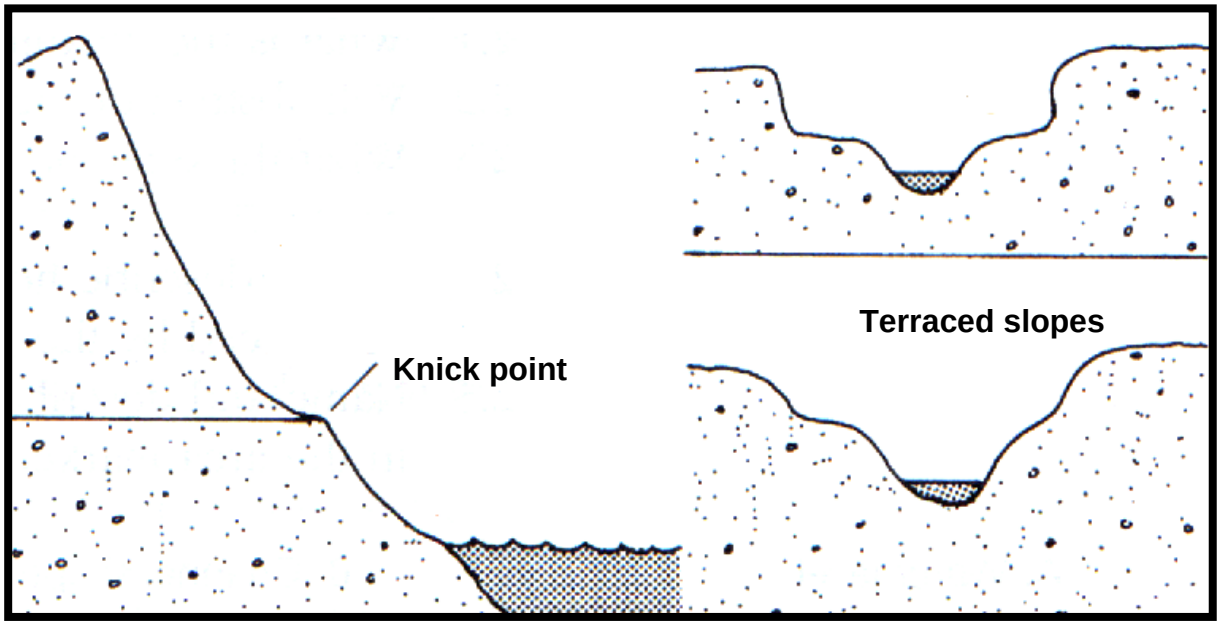
- Along meanders the cross section is asymmetrical as more erosion along the cut bank causes it to be deeper.

1.3. Stages of a river along a graded river profile



2. What is rejuvenation?

- Rejuvenation takes place when a stream has more erosive power and takes on characteristics of the youth stage, namely downward erosion, deep valleys, waterfalls and rapids develop in the old or mature stages.
- Rejuvenation can be caused by:
  1. Climatic changes that causes more rain and run-off;
  2. River capture that increases the run-off in the captor stream;
  3. Isostacy (up and down movements of continents) that is caused by rising land masses or sinking sea levels.
- The river cuts its valley deeper and terraces, entrenched / incised meanders and knick points develop along the stream profile. The river needs to grade itself again.
- Most of the rivers along the East coast of South Africa have been rejuvenated as the sub-continent is rising due erosion that is making the continent lighter.



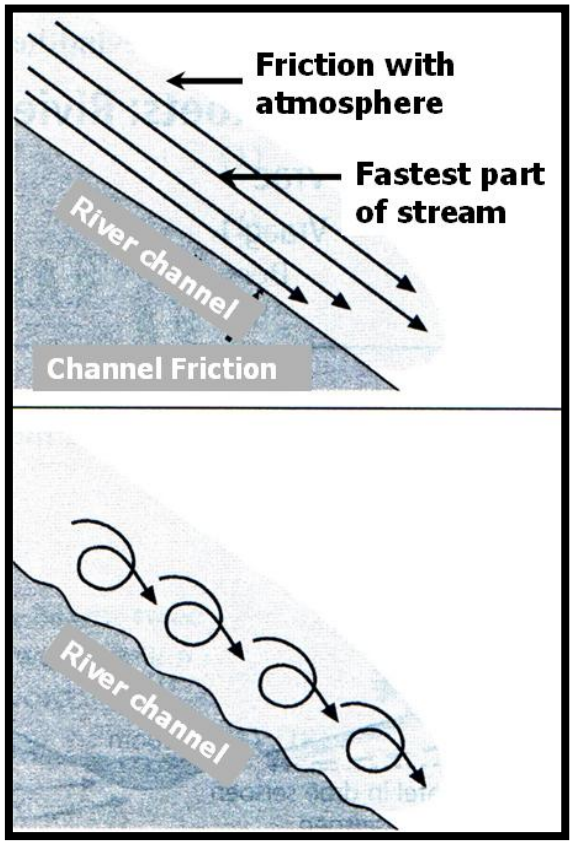
3. Stream channel characteristics

3.1. Types of flow

3.1.1. Turbulent flow

Occurs where the slope is steep and the channel uneven – white water cuts into valley.

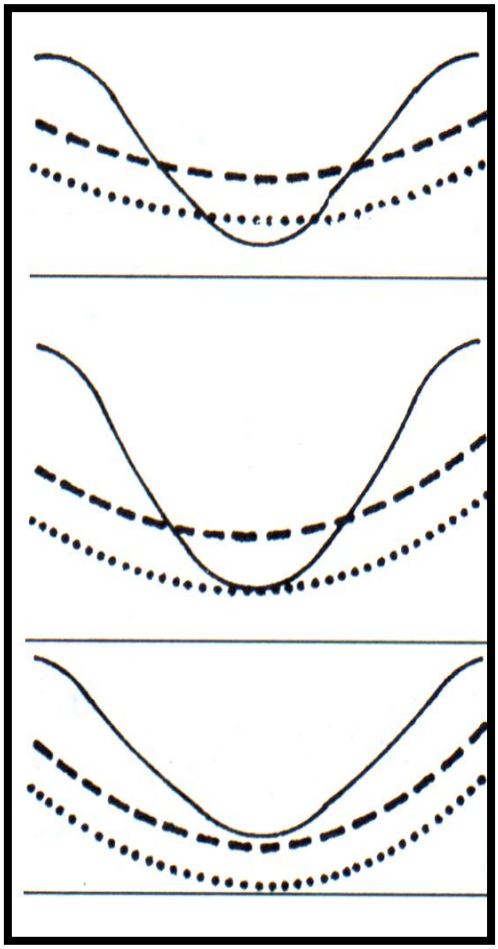
- ❖ Circular action
- ❖ Downward erosion
- ❖ Uneven stream channel
- ❖ Give river a white bubbly appearance
- ❖ Occur in the youth stage
- ❖ Carries a lot of bed load



3.1.2. Laminar flow

Water flow in layers when the channel is smooth and not too steep

- ❖ Water flow in layers
- ❖ Smooth stream channel
- ❖ Inner layers flow fast
- ❖ River flow over gradual gradient
- ❖ Smooth water surface
- ❖ In mature and old age stage



4. Types of rivers:

- Permanent rivers flow all the time due to continuous base flow even though the direct run-off may vary. They occur in high rainfall areas, e.g. Tugela river.
- Periodic rivers flow every rainy season when they receive direct and indirect run-off, but dry up when the water table drops during the dry season. They occur in semi-arid areas, e.g. most rivers in the central part of South Africa.
- Episodic rivers flow occasionally when it rains in a dry area. In many cases the river does not even reach the sea as infiltration takes place fast, because the water table is always deep below the valley floor, e.g. Aub and Nossob rivers
- Exotic rivers flow all the time through dry areas, because they receive water from more humid areas upstream, e.g. Nile and lower part of the Orange River.

- - - - - Water table in rainy season
…… Water table in dry season

4.1. Stream channel patterns:

The material that a stream flows over influences the stream channel pattern.

- Meandering stream channels develop on sticky more stable alluvium in the mature stage of the river.
- Rock controlled stream channels follow the weaknesses in the rock as a river flows over a rock mass. This occurs most often in the youth stage of the river.
- Braided stream channels occur on loose, sandy alluvium where the stream often blocks itself and forms new streams around the sandbanks. It occurs most often in the old age stage.

4.2. Stream flow characteristics:

- Flow hydrographs illustrate the difference in discharge over shorter or longer periods of time.
- The shape of a flow hydrograph is influenced by the type and drainage pattern of the river, the shape of the drainage basin, the infiltration / run-off rate, and the amount of rainfall.
- Stream discharge is the amount of water that flows pass a point in a stream measured in cumec (cubic m / second)
- There is normal and abnormal river flow.

SECTION C: HOMEWORK

QUESTION 1: 5 minutes 10 marks *(Source: DoE November 2009)*

Refer to the figure below showing different features of river capture. Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number as an answer.

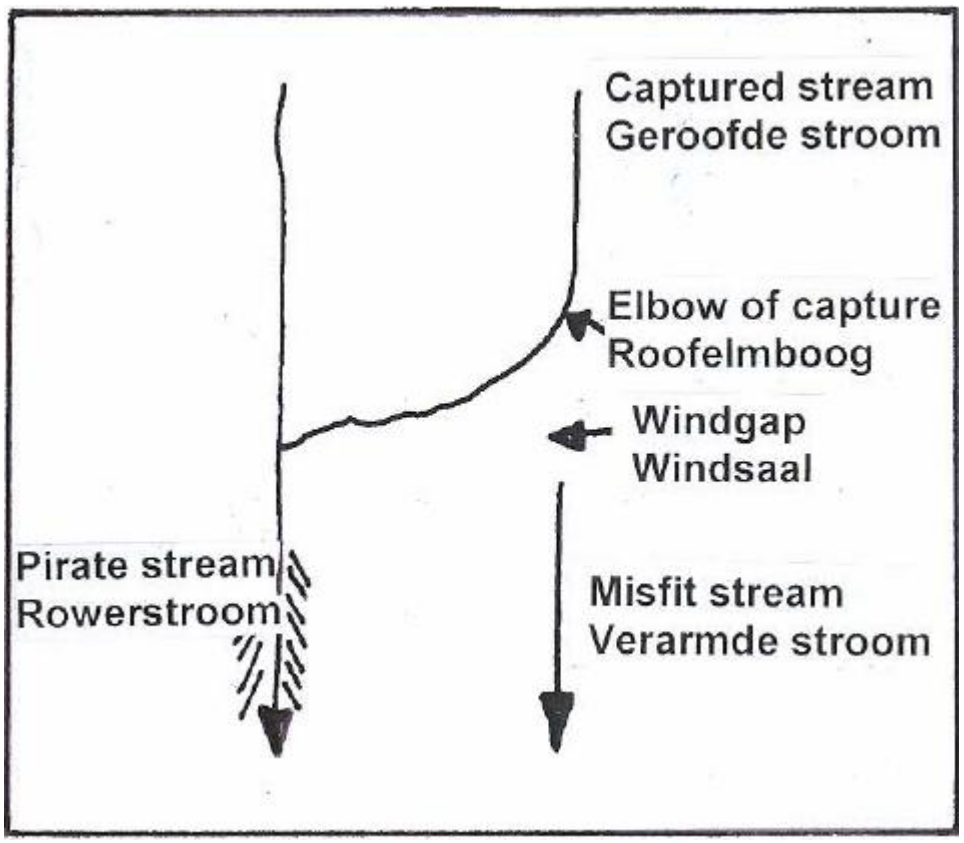
1.1 A stream whose headwaters have been intercepted.

1.2 A stream that is smaller than the valley through which it flows.

1.3 The point where an energetic stream intercepts the water of another stream.

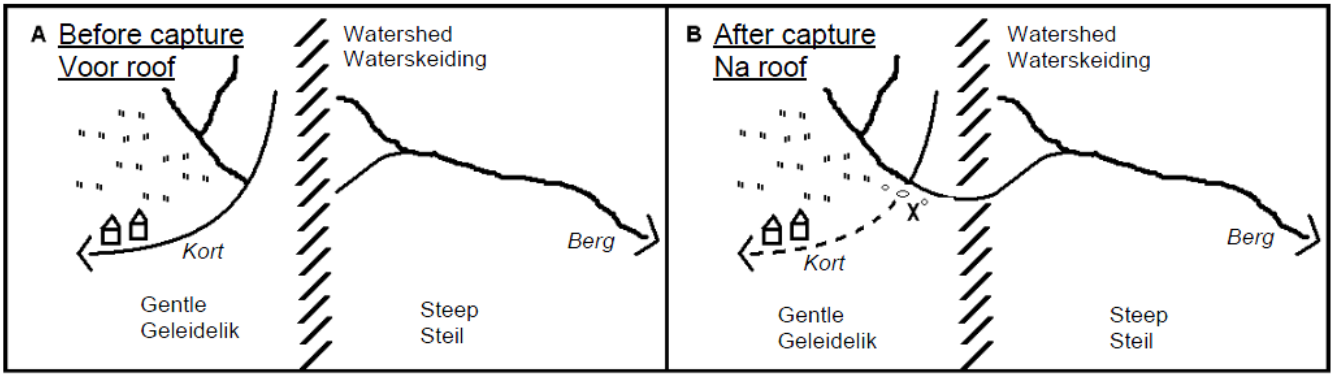
1.4 A dry valley where no stream flows.

1.5 A stream that intercepts the water of another stream. (5 x 2) [10]



QUESTION 2: 20 minutes 24 marks *(Source: DoE November 2010)*

2. The FIGURE below illustrates the concept of river capture/stream piracy.



2.1 Name ONE factor which could have resulted in the Berg River eroding through the watershed to capture the Kort River. (1 x 2) (2)

2.2 Name TWO features of river capture that could develop at point X. (2 x 2) (4)

2.3 Why is the beheaded stream (Kort River) in sketch B referred to as a misfit stream? (1 x 2) (2)

2.4 Name TWO effects that river capture has on the captor stream (Berg River) in sketch B. (2 x 2) (4)

2.5 Write a single paragraph (no more than 12 lines) presenting a detailed report on how river capture influences human activities along the Kort and the Berg Rivers respectively. (6 x 2) (12)

[24]

QUESTION 3: 12 minutes 12 marks *(Source: DoE March 2009)*

Refer to the figure on the following page illustrating the cross profile of a river, before answering the questions that follow.

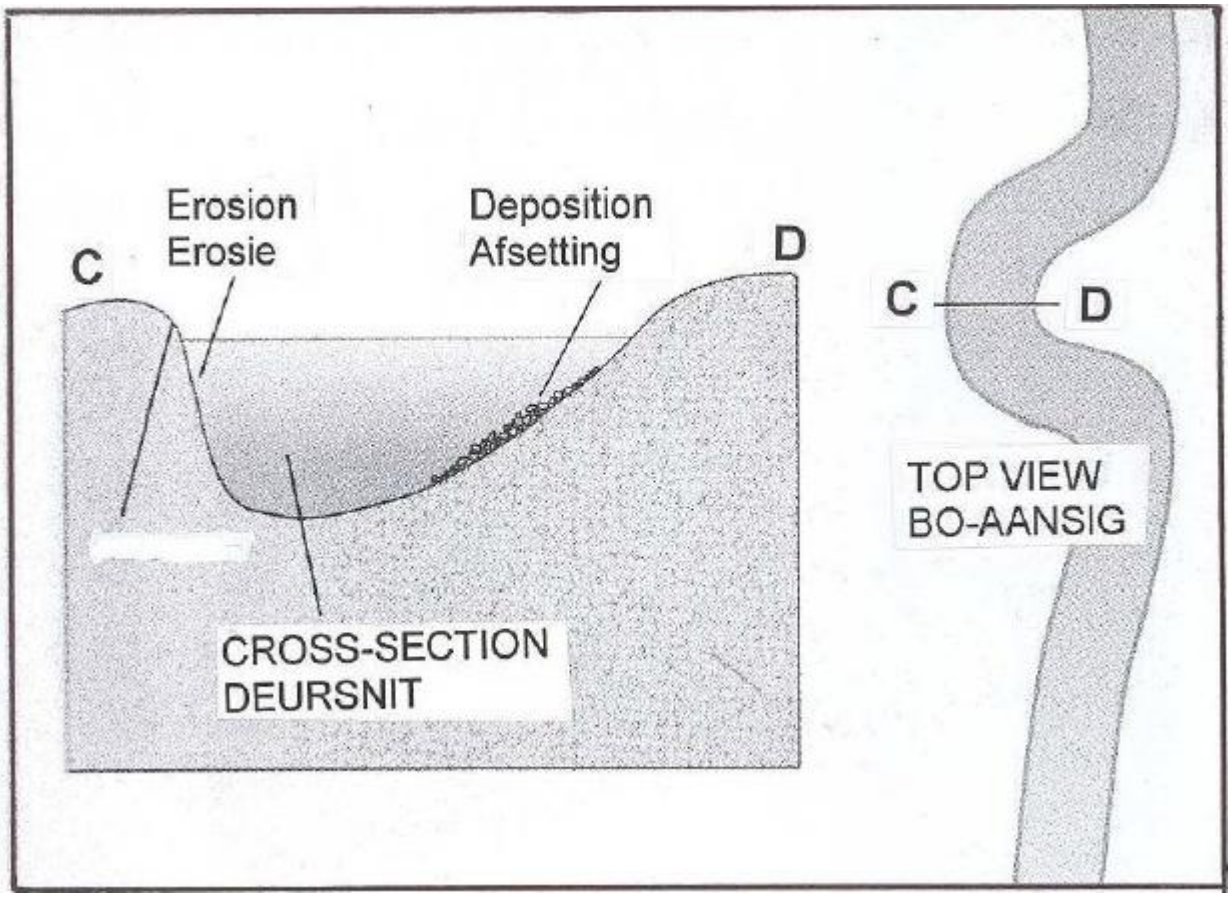
3.1 Identify the river banks (slopes) C and D respectively. (2 x 2) (4)

3.2 Why does deposition occur on the inner bend? (1 x 2) (2)

3.3 Give and explain ONE way in which a river carries its load. (2 x 2) (4)

3.4 Explain why flooding is more likely to occur after heavy rains along the bend of a river. (1 x 2) (2)

[12]



SECTION D: SOLUTIONS AND HINTS TO SECTION A: TOPIC 2

QUESTION 1

1.1 Graded profile/concave/smooth ✓✓ (1 x 2) (2)

1.2 (a) K ✓✓ (1 x 2) (2)

(b) Vertical/downward erosion ✓✓
Because of fast-flowing water ✓✓
Debris that acts as a cutting tool ✓✓
Bed load rolls over river bed ✓✓
K is in upper course ✓✓

OR

Lateral erosion ✓✓
Rounded slopes of valley ✓✓
Valley is widening ✓✓
Symmetrical profile ✓✓
Mass wasting along slopes ✓✓
Middle course ✓✓

[Any ONE] (2 x 2) (4)

(c) Width of a river ✓✓
Depth of a river ✓✓
Fluvial stage of river ✓✓
Rock type/resistance ✓✓
Shape of the valley ✓✓
Gradient of river ✓✓
Could indicate rejuvenation ✓✓ [Any TWO] (2 x 2) (4)

1.3 A meander is a bend along the course of a river ✓✓
After heavy rainfall the water is fast flowing and cuts/erodes into the outer bank (undercut slope) of a river ✓✓
Meander neck is reduced ✓✓
Water is slow moving on the inner bank (slip-off) resulting in deposition ✓✓
After a period of time when the river cannot negotiate the bend, it will cut through the meander neck (cut off the loop), forming an ox-bow lake ✓✓
Stream will now follow a straight path ✓✓
River will start to meander again ✓✓
The meandering river migrates ✓✓
[Any FOUR] (4 x 2) (8)

1.4 Contamination of water – cannot be used for domestic purposes ✓✓
Cholera ✓✓
Affects the health of people ✓✓
Reduces food supply from the river ✓✓
Loses scenic beauty ✓✓
Limits recreational activities ✓✓
Reduce income ✓✓
[Any TWO. Accept reasonable answer] (2 x 2) (4)
[24]

QUESTION 2

2.2.1 S ✓✓
2.2.2 Headward ✓✓
2.2.3 Misfit ✓✓
2.2.4 T ✓✓
2.2.5 Windgap ✓✓ (5 x 2) **[10]**

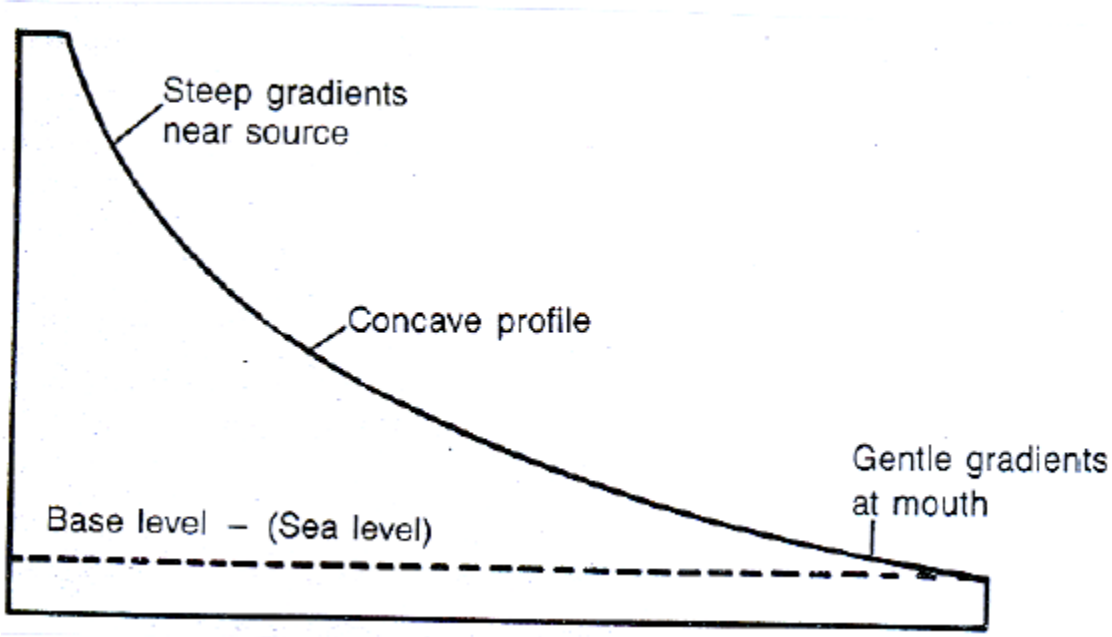
QUESTION 3

3.1 (a) Smooth profile showing a river in which there is an equilibrium between erosion and deposition ✓✓ [CONCEPT] (1 x 2) (2)

(b) The lowest level to which a river can erode ✓✓ [CONCEPT] (1 x 2) (2)

3.2.

(1 x 2) (2)



3.3 Knick-point ✓✓New base level ✓✓
New graded profile ✓✓ [Any ONE] (1 x 2) (2)

3.4 Drop in base level ✓✓
Land rises ✓✓
Periods of glaciation ✓✓
Prolonged higher rainfall ✓✓
Tectonic change in the landscape ✓✓
Global warming increase melt water ✓✓ [Any TWO] (2 x 2) (4)

3.5 **Advantages**

Water can be stored ✓✓
Can be used for household purposes ✓✓
Can be used for irrigation ✓✓
Can be used for industries ✓✓
Infrastructural development ✓✓
Economic advantages ✓✓
Flood control (✓✓
Periodic stream can become permanent ✓✓
Recreational facilities and tourism ✓✓

Disadvantages

Characteristics of the river channel will change (✓✓
Lower reaches of the river may be dry most of the time ✓✓
People living in the lower reaches might not be able to practice crop farming ✓✓
Flow characteristics of river will also change ✓✓
Displacement of local inhabitants ✓✓
Local ecosystems destroyed ✓✓

[Accept other reasonable answers]
[Any SIX. Must give advantages and disadvantages] (6 x 2) (12)

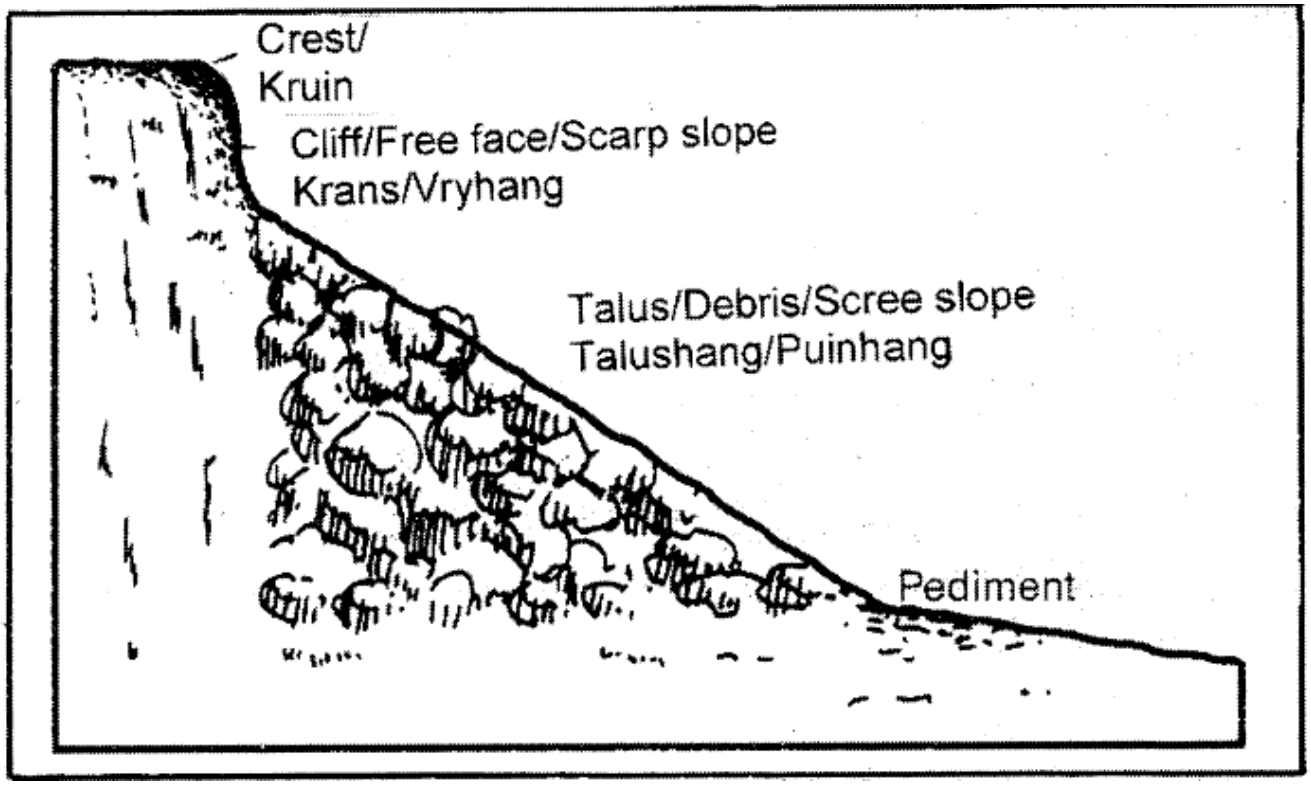
TOPIC 1: FLUVIAL LANDFORMS, CATCHMENT AND RIVER MANAGEMENT, SLOPES AND MASS MOVEMENT

Learner Note: Questions on this section may be asked as part of other earlier mentioned sections. In the final exam, you must be able to understand the relationship between all the subsections of each chapter of work.

SECTION A: TYPICAL EXAM QUESTIONS: TOPIC 1

QUESTION 1: **5 minutes** **10 marks** *(Source: DoE March 2010)*

Use the figure below showing the four slope elements to assist you in giving ONE word/term for each of the following descriptions. Write only the term next to the question number, for example 1.6 base flow. The same term may be used more than once.

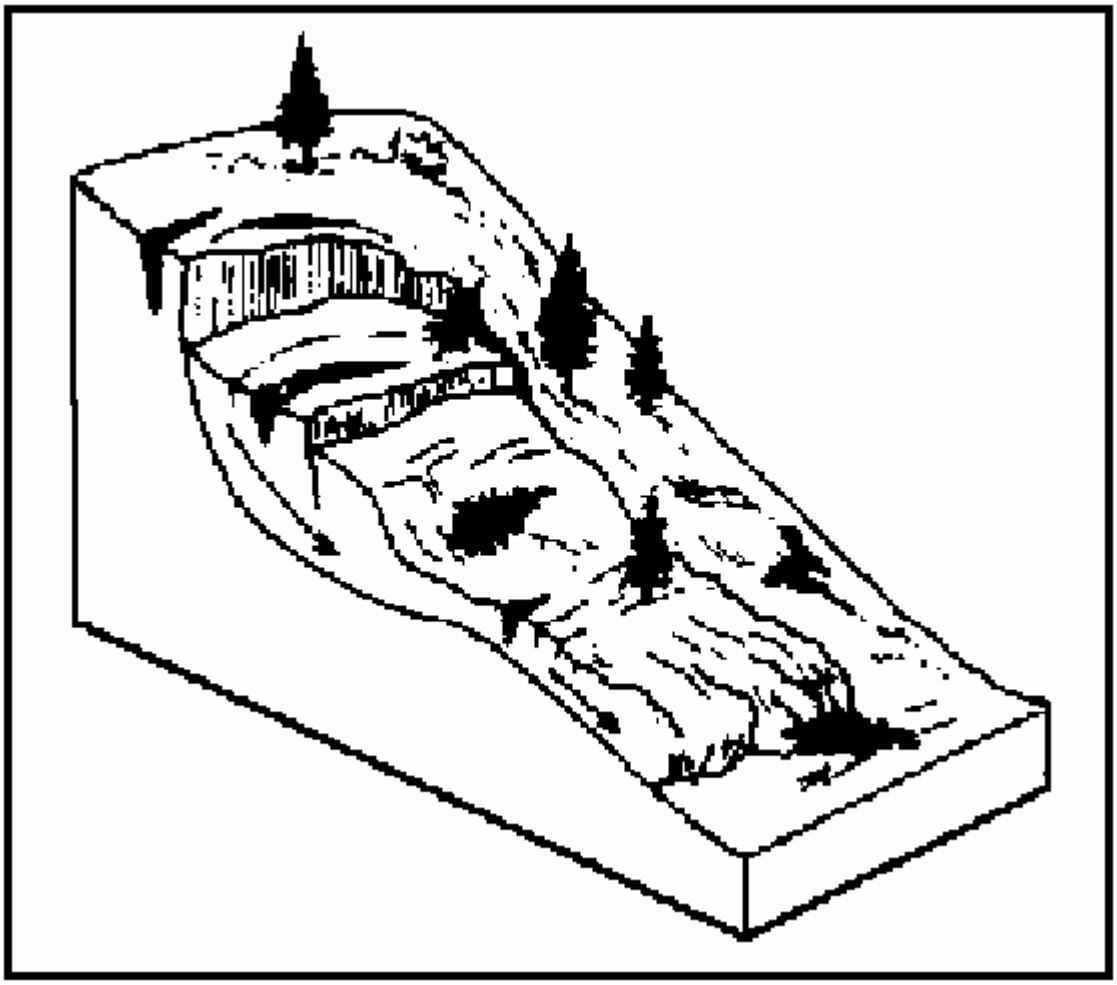


1.1 Slope element with a convex shape
1.2 Low-angle slope element
1.3 Soil creep occurs on this slope element
1.4 Slope element that is a rocky, vertical outcrop
1.5 Slope element composed mainly of weathered material (5 x 2) [10]

HINTS: Slopes elements are always in the papers; they are easy marks so study them well.

QUESTION 2: 25 minutes 32 marks *(Source: DoE November 2010)*

The figure below contains information on a type of mass movement (mudslide).



400 buried in Taiwanese mudslide

Taipei: A mudslide touched off by a typhoon has buried a mountain village in Taiwan, leaving at least 400 people unaccounted for. Typhoon Morakot slammed Taiwan over the weekend with 2 000 mm of rain. A disaster appeared to be unfolding at the southern village of Shiao Lin, hit by a mudslide on Sunday and now cut off by land from the outside world. A Taiwanese official said 400 people were unaccounted for in the village.

2.1. What evidence in the sketch indicates that a mudslide has occurred? (2 x 2) (4)

2.2. How was typhoon Morakot responsible for triggering the mudslide in Taiwan? (2 x 2) (4)

2.3. State the economic impact of mass movements on small villages like the one in Taiwan. (4 x 2) (8)

2.4. Suggest four ways in which humans are responsible for causing mass movements. (4 x 2) (8)

2.5. Explain what precautionary measures (methods) people should adopt (put in place) before using slopes for development. Mention four measures. (4 x 2) (8)

[32]

QUESTION 3: 5minutes 10 marks *(Source: DoE November 2010)*

Study the figure below showing a photograph of a section of a river. Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A – D) next to the question number.

3.1. The feature labelled Y is a/an …

A undercut slope.
B slip-off slope.
C ox-bow lake.
D dip slope.

3.2 The section of the river shown in the photograph is in its … course.

A upper
B middle
C lower
D base

3.3 During a flood the river is likely to break through at point Z, resulting in the formation of a/an …

A rapid.
B ox-bow lake.
C meander.
D floodplain.

3.4 The river shown in this photograph flows throughout the year and is, therefore, referred to as …

A episodic.
B permanent/perennial.
C seasonal.
D periodic.

3.5 The river shown in this photograph displays a … stream channel pattern.

A dendritic
B braided
C rock-controlled
D meandering (5 x 2) [10]

HINTS

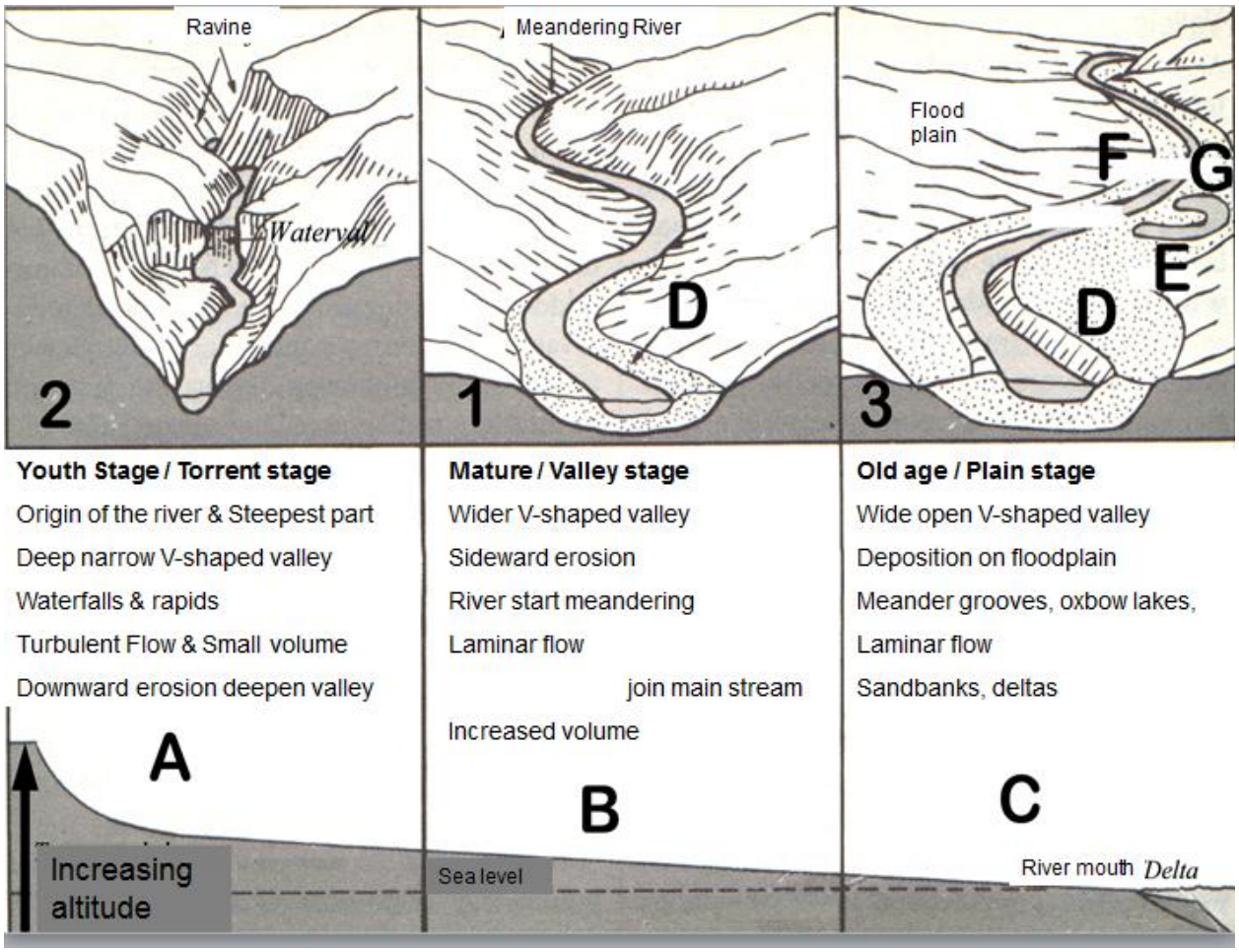
Hint 1 – Always give an answer – never leave an answer out

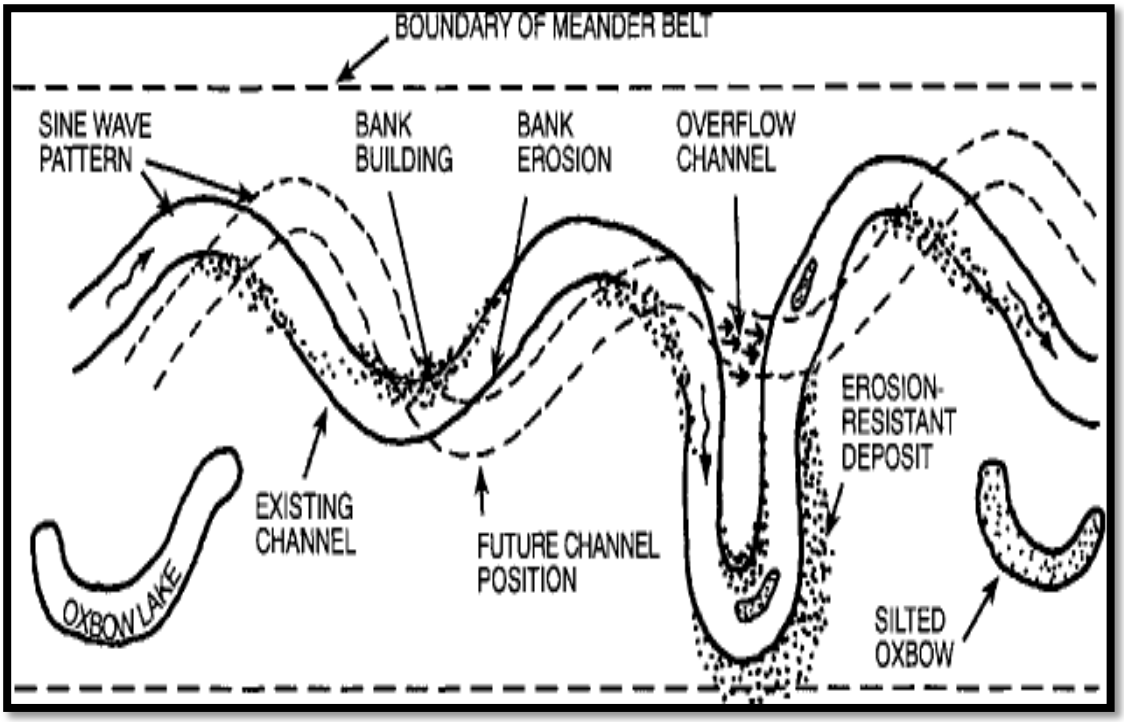
Hint 2 – Write capital letters as answers when answering multiple-choice questions so as to prevent confusion..

SECTION B: ADDITIONAL CONTENT NOTES

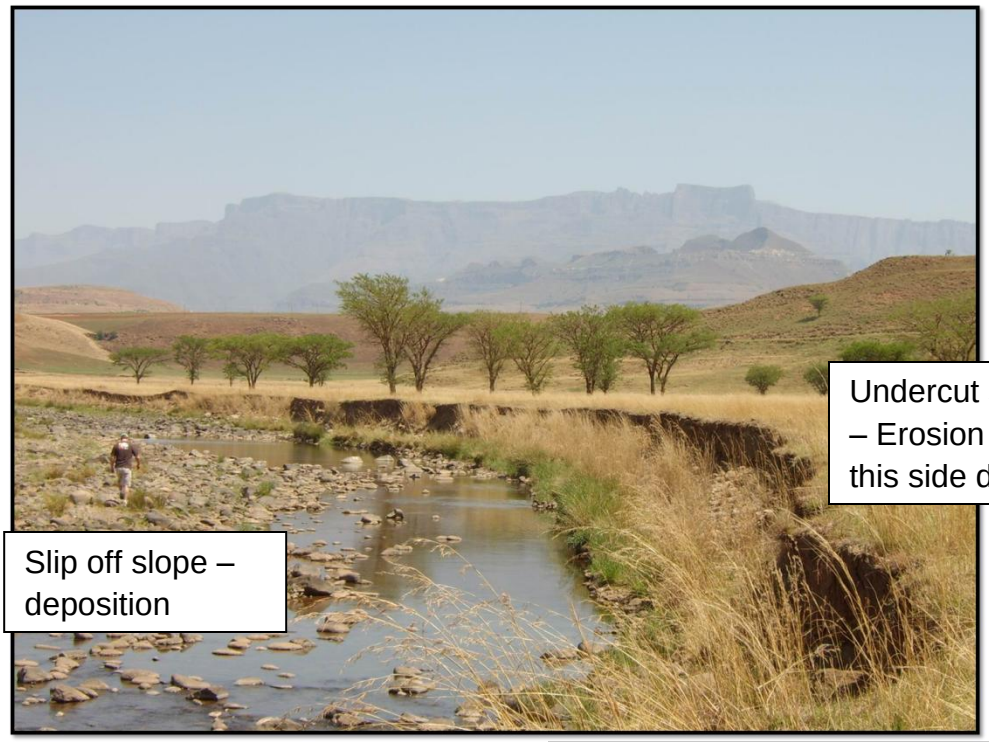
River Land Forms

Rivers form landforms as they erode the landscape. These landforms change over time as more erosion and deposition take place. Different landforms develop at different stages of a river course. The floodplain in the old age stage gives rise to a number of landforms as illustrated on the following page:


Ravine
Waterval
Meandering River
D
Flood plain
F
G
E
D
2
1
3
Youth Stage / Torrent stage
Origin of the river & Steepest part
Deep narrow V-shaped valley
Waterfalls & rapids
Turbulent Flow & Small volume
Downward erosion deepen valley
Mature / Valley stage
Wider V-shaped valley
Sideward erosion
River start meandering
Laminar flow
join main stream
Increased volume
Old age / Plain stage
Wide open V-shaped valley
Deposition on floodplain
Meander grooves, oxbow lakes,
Laminar flow
Sandbanks, deltas
A
B
C
Increasing altitude
Sea level
River mouth
Delta


BOUNDARY OF MEANDER BELT
SINE WAVE PATTERN
BANK BUILDING
BANK EROSION
OVERFLOW CHANNEL
EROSION-RESISTANT DEPOSIT
EXISTING CHANNEL
FUTURE CHANNEL POSITION
OXBOW LAKE
SILTED OXBOW

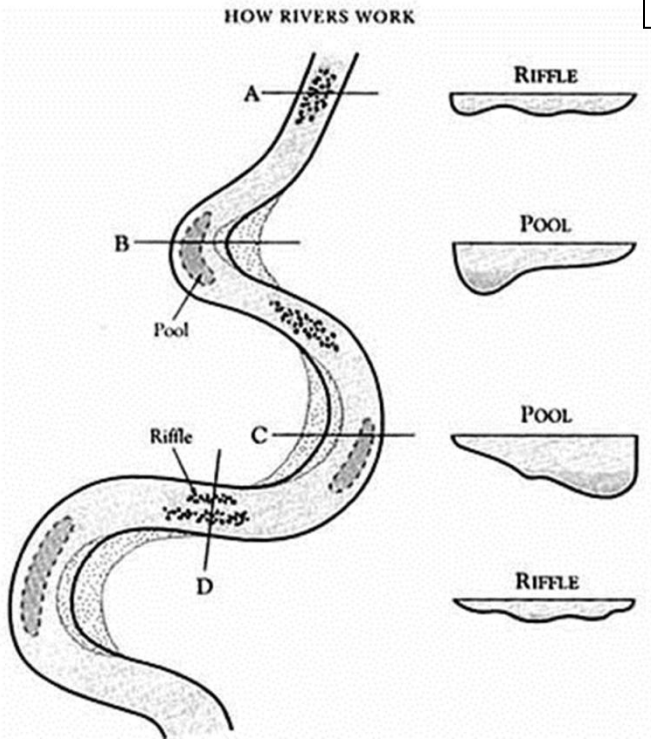
Floodplain

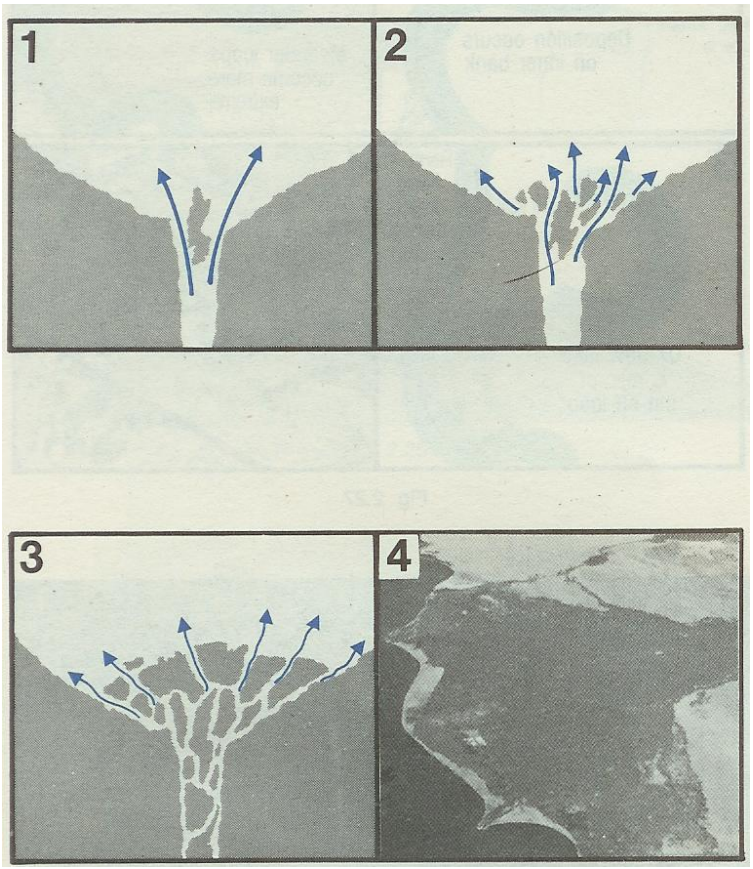


Undercut slope – Erosion cuts this side deeper.

Slip off slope – deposition

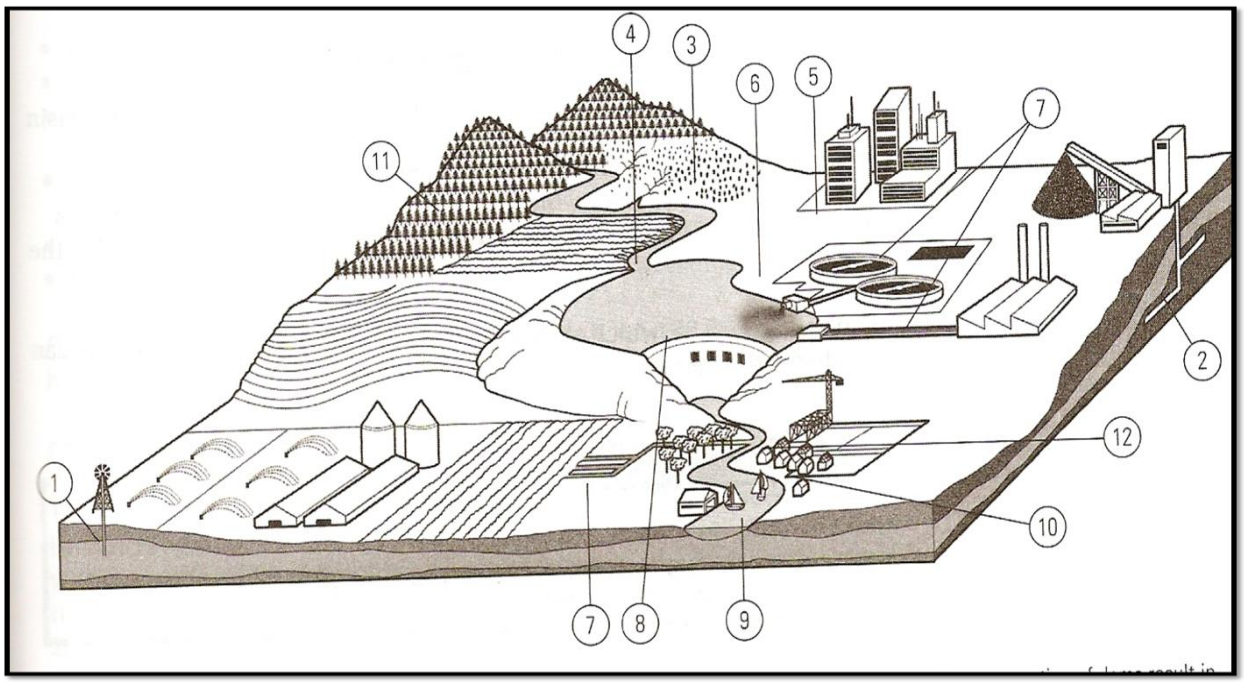
A River builds a delta out into the sea by depositing stream load in the river mouth along shallow coastlines with slow currents. New land is formed





Management of River Catchment Areas

- ✓ Although about 70% of the earth's surface is covered by water, only 2% of the earth's water is fresh water suitable for human use.
- ✓ This fresh water supply comes from rivers, dams and groundwater sources.
- ✓ Population growth, the expansion of agriculture and industry, and increasing urbanisation mean more water is needed.
- ✓ People rely on rivers to provide water for many activities.
- ✓ Without water there can be no agriculture, no industry, no business and no development.
- ✓ People need the water from rivers for their homes.
- ✓ Rivers and dams provide people with hydro-electricity.
- ✓ Rivers supply us with food, and areas are used for recreational activities, tourism, cultural activities and settlement.
- ✓ Bird and wildlife depend on rivers and the vegetation in the RIPARIAN ZONE.
- ✓ Rivers and their catchment areas need to be monitored and managed so that everyone can have access to water, so that the ecosystems of the rivers remain healthy, so that flooding can be controlled and sustainable development can be maintained.
- ✓ Do not build within the 50 year flood line of a river.
- ✓ Do not take out the natural vegetation around rivers.
- ✓ Do not allow overgrazing.
- ✓ Build dams to regulate flooding, but ensure they can cope with flood capacity of rivers.
- ✓ Build bridges way above the normal level of the river.
- ✓ Conserve wetland and marshes as they absorb a lot of the flood waters.
- ✓ Build channels in urban areas that still allow infiltration.
- ✓ Build embankments on either side of the channel
- ✓ Cut through meander loops.



1 Boreholes remove water from the saturated groundwater zone, so less groundwater flows into the river.

2 Groundwater can be polluted by human activities such as mining.

3 Overgrazing and the clearing of vegetation in the catchment area of a river decreases the amount of infiltration and therefore the supply of groundwater flowing into the river. The amount of water flowing over the land surface increases, so water containing a lot of silt enters the river.

4 Runoff in agricultural areas contains high amounts of salt, nutrients and pesticides, which are harmful to aquatic life and the aquatic food chain and can lead to an increase in algae in the water.

5 Surfaces in urban areas are covered with concrete and tar, which is impermeable. Infiltration decreases and the amount of water flowing over the land surface increases. This, together with the removal of vegetation, causes a shorter lag time and higher flood peak, which can lead to flooding in urban areas.

6 Many wetland areas have been converted to crops, commercial timber plantations of alien trees, waste disposal sites, pastures and dams. Often wetland areas are badly polluted by industry, sewerage works, mines and agriculture.

7 Removing water for irrigation, domestic use, industry and mines changes the flow of the river, reduces river habitats and affects the ecological processes of the river. The return water flows from these activities affect the quality of the water. Mismanaged sewerage works can lead to excess sewage going into rivers.

8 Water transfer schemes and the construction of dams result in unnatural flow patterns and disturb the river's ecology. The river deposits some of its load in the dam, but then has excess energy to erode the channel downstream of the dam. Although a dam reduces the damage to people and their homes caused by floods, it disrupts the life cycles of some species. Many people lose their homes when parts of the drainage basin are flooded to create the dam.

9 Recreational activities in the riparian zones disrupt the ecology and result in litter and other forms of pollution.

10 Settlement and construction within the riparian zone is often too close to the banks of the river or on the flood plain. This disrupts the natural flow of the river, and can cause the banks of the river to collapse.

11 People introduce alien plant species, such as willows, blue gums and poplar trees, which use an excessive amount of water within the zone of the river. Alien fish compete with indigenous species, and there is a resultant loss of diversity in the river. Many of our rivers have been invaded by the alien water hyacinth plant.

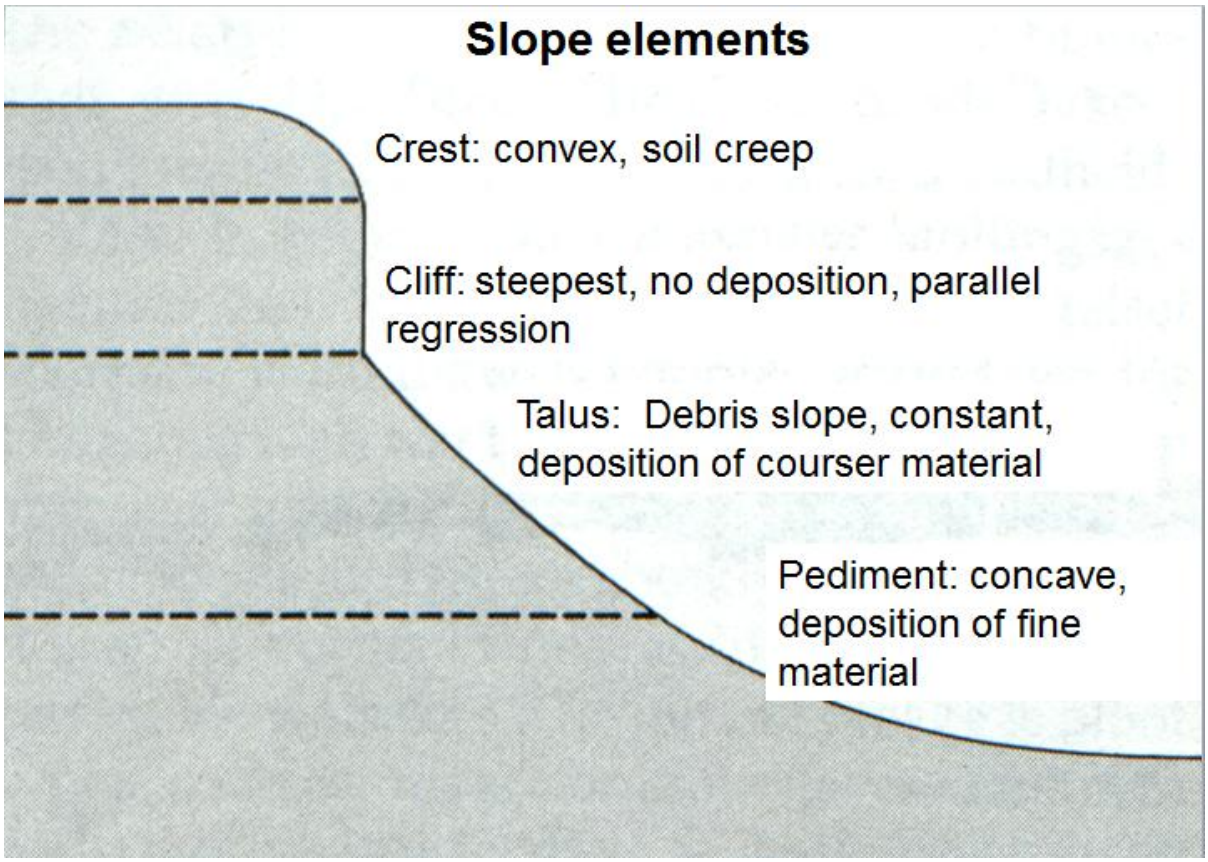
12 Flood control methods, such as turning river channels into canals, the construction of artificial embankments and cutting through meander loops, change the flow of the water and prevent natural flooding and the renewal of the flood plain's fertility.

Extract From Focus on Geography for Gr. 12

Slope Elements

Characteristics of the slope elements

- **Crest:** convex top of slope, soil creep
- **Cliff / Scarp / Free face:** steepest part of slope, no deposition, parallel retreat due to undercutting of hard rock.
- **Talus / Scree / Debris slope:** constant slope, steeper if debris is larger, deposition from the crest and cliff takes place here.
- **Pediment:** Concave bottom part of the slope where all the finer material is deposited. It becomes wider as the valley is eroded more to form the flood plain of rivers.

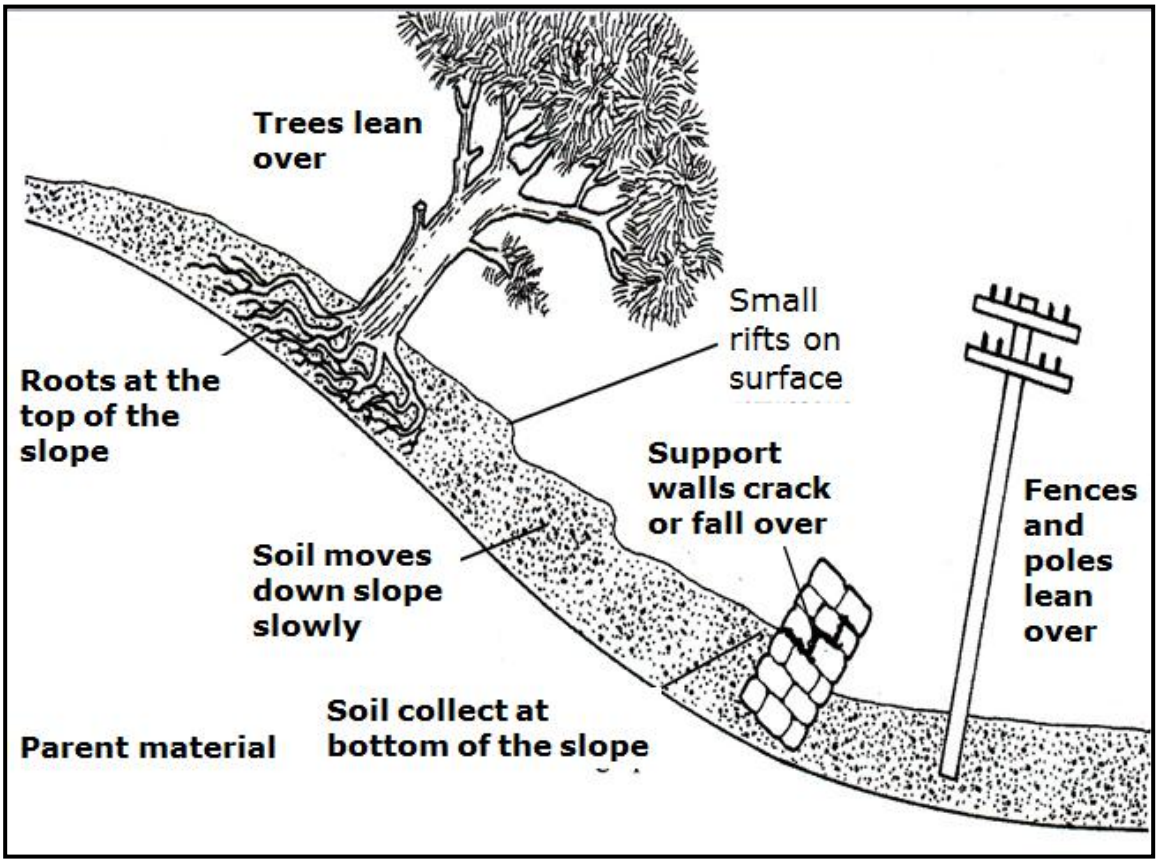


Impact of Slopes on Human Activities

- ✓ Settlement: people build homes on slopes when space is limited or for the view that their home will have.
- ✓ Agriculture: Steep slopes used for forestry. Vineyards found on gentle slopes. Contour ploughing and terracing.
- ✓ Recreation : hiking
- ✓ Communication: Barriers. Mountain passes.

Mass Wasting – when material moves down slopes under the influence of gravity.

- ✓ Soil creep: soil moves down slope due to expansion and contraction as a result of temperature changes
- ✓ Flowage: soil saturated with water
  - Solifluction: occurs when soil slides on frozen ground beneath it
  - Earth flow: clay that moves down slope in large mass
  - Mud flow: channels of mud flow downhill fast
- ✓ Rock falls: individual rocks break off and fall down the side of cliffs
- ✓ Landslides: large part of rock breaks loose and slides down the slope



SECTION C: HOMEWORK

QUESTION 1: 25 minutes 28 marks *(Source: DoE November 2009)*

Read the information given below and use the accompanying sketches to answer the questions

1.1. Define the term mass movement. (1 x 2) (2)

1.2. Match the types of mass movement illustrated in sketches (i) and (ii) in figure 1A with the slopes P and Q in figure 1B respectively. In each case, give ONE reason for your choice. (4 x 2) (8)

1.3. Identify the slopes P and Q in the sketch above. (2 x 2) (4)

1.4. State the main difference between the two types of mass movement illustrated in sketches (i) and (ii) in FIGURE 1A. (1 x 2) (2)

1.5. Poor management of slopes, such as deforestation and poor farming methods, has a detrimental effect on economic activities along these slopes. With reference to the article below and sketch (ii) in FIGURE 1A, write a short essay (no more than 12 lines), highlighting man's contribution to increasing mass movements along slopes, the economic consequences thereof, and what could be done to rectify the situation. (6 x 2) (12)

[28]

CAUSE AND MANAGEMENT OF MASS MOVEMENTS

Landslides cause destruction of lives and property and also displacement of large numbers of people. There are instances where whole villages have been totally destroyed by landslides.

Apart from the natural factors, man's unwarranted intervention with the environment by way of deforestation, cultivation on slopes, non-engineered construction, obstructing natural drainage, improper drainage, mining and quarrying causing artificial vibration coupled with continuous heavy rainfall or excessive rainfall, may lead to landslides.

The National Building Research Organisation (NBRO) of Sri Lanka is an institution responsible for giving timely information of an impending landslide. In order to identify landslide-prone areas, a Landslide Hazard Zonation Mapping project is in progress in this country. Research has been undertaken in respect of hydrology, geology, slope and soil types for identification of different hazard potential. The NBRO promotes the following:

- Mapping of the distribution of landslides hazard potential in the highlands of Sri Lanka.
- Introduction of standard guidelines and codes on practices for planning human settlements and infrastructure in the landslide-prone areas.
- Establishment of sustained long-term and short-term mechanisms for landslide disaster management in Sri Lanka.

Landslide occurrences are closely associated with rainfall. Therefore, the Meteorology Department also plays an important role by providing weather-related information.

The NBRO also promotes the creation of public awareness about causative factors of landslides. The factors that should be considered, while being watchful during heavy rainfall, can be summarised as follows:

- Big boulders would start moving.
- Trees would slant towards the slope.
- Cracks would appear on the walls and other structures.
- Springs and water spouts would appear and there will be a rise in the water level.
- The earth itself would show cracks and fractures.

Figure 1A

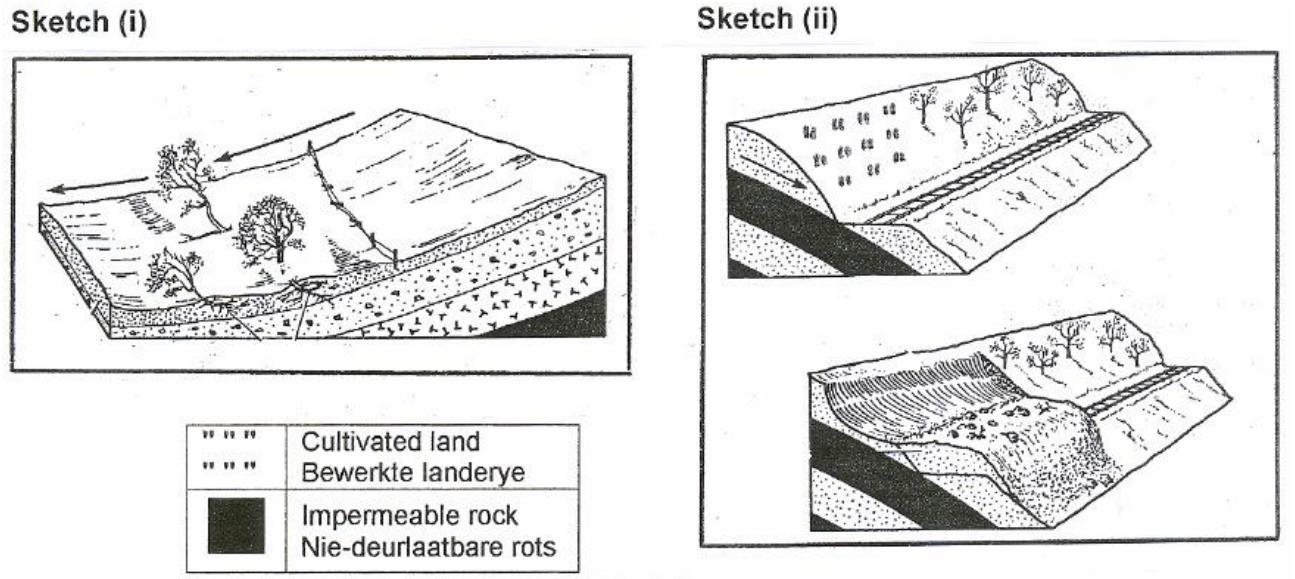
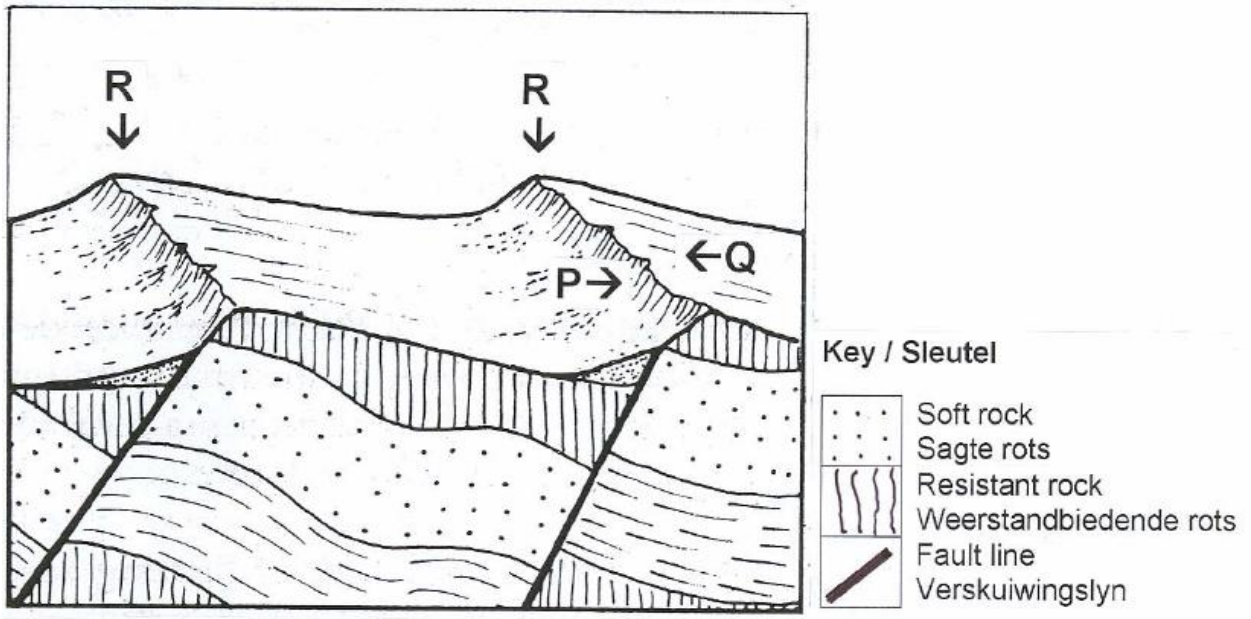


Figure 1B



QUESTION 2: **5 minutes** **10 marks** *(Source: DoE November 2009)*

Refer to FIGURE 2.2 illustrating the four slope elements/forms. Choose the correct term from those given in brackets to make all the statements below TRUE. Write only the term next to the question number.

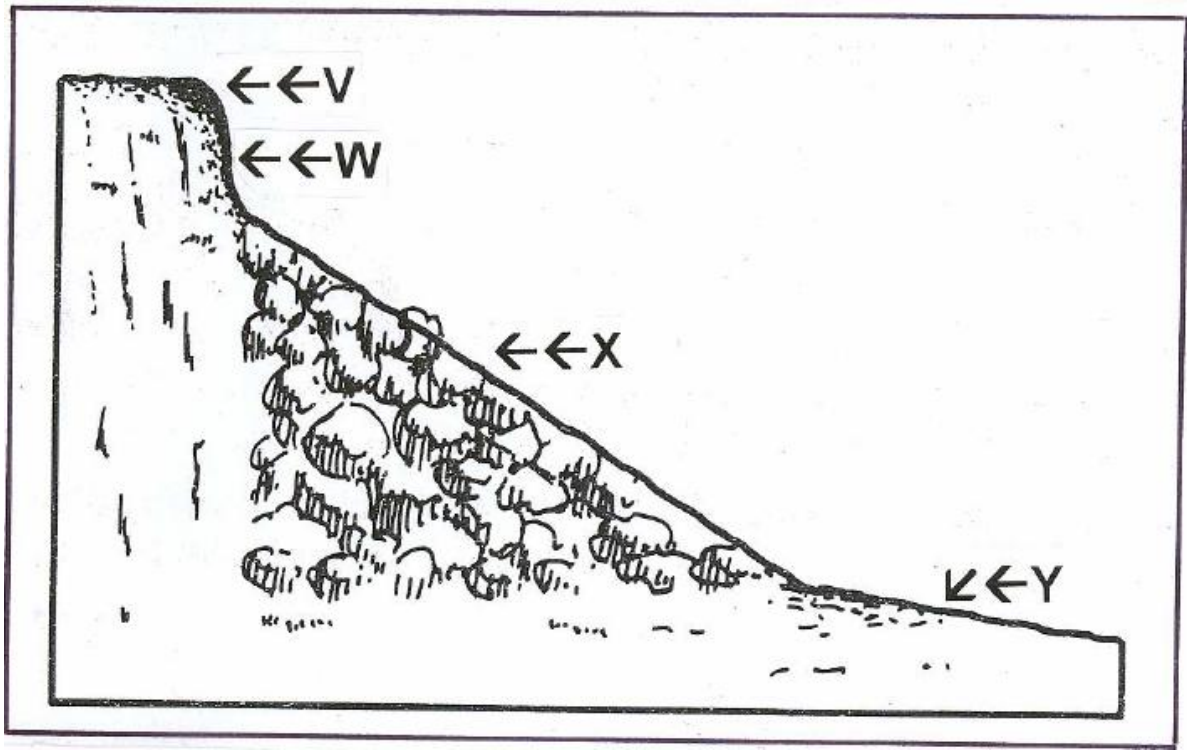


Figure 2.2

2.1. The landform illustrated in the figure above is associated with (tilted/horizontal) sedimentary rock layers.
2.2. Slope element W is called the (crest/cliff).
2.3. Slope element W consists of (soft/resistant) rock.
2.4. The angle at which slope element X develops (remains constant/changes constantly).
2.5. Slope element Y gets (wider/narrower) as slope element X retreats. (5 x 2) [10]

SECTION D: SOLUTIONS AND HINTS TO SECTION A

QUESTION 1

1.1 Crest ✓✓
1.2 Pediment ✓✓
1.3 Crest ✓✓
1.4 Cliff/ Free face/Scarp slope ✓✓
1.5 Talus/Debris/Scree slope ✓✓ (5 x 2**) [10]**

QUESTION 2

2.1 Bending/falling over of trees.✓✓
The steep break in the upper slope.✓✓
Arrows show the movement of mud downslope ✓✓
[Any TWO] (2 x 2) (4)

2.2 Heavy (2 000 mm) rain/floods ✓✓
Soil became saturated ✓✓ [Any TWO] (2 x 2) (4)

2.3 Mud destroys agricultural land ✓✓
Less food production ✓✓
Loss of jobs ✓✓
Damage to infrastructure ✓✓
Much capital spent on restoration of infrastructure ✓✓
Houses destroyed ✓✓
Costly to rebuild ✓✓
Loss of lives ✓✓ [Any FOUR. Accept other reasonable answers] (4 x 2) (8)

2.4 Deforestation/clearing of vegetation ✓✓
Building on steep slopes ✓✓
Poor drainage ✓✓
Down-slope ploughing ✓✓
Allowing too many tourists on steep slopes that dislodge rocks ✓✓
Overloading slopes with buildings ✓✓
Blasting ✓✓
Road construction and quarrying upset the balance of slopes ✓✓
Non-engineered construction of roads on slopes ✓✓
[Any four. Accept any other reasonable answers] (4 x 2) (8)

2.5 Plant trees to bind the soil ✓✓
Stabilise the slopes by erecting wire meshes ✓✓
Place stone walls, nuts and bolts, ground anchors, buttresses, drainage channels, drill bolts into the side of the hill slopes ✓✓
Anti-erosion fence / wall ✓✓
Cement barriers ✓✓
Spray slopes with concrete ✓✓
[Any FOUR. Accept any other reasonable answers] (4 x 2) (8)
[32]

QUESTION 3

3.1 B ✓✓
3.2 C ✓✓
3.3 B ✓✓
3..4 B ✓✓
3.5 D ✓✓ (5 x 2) **[10]**

TOPIC 2: MAP CALCULATIONS

Learner Note: The calculations part of the mapwork paper counts 20 marks and you should get good marks here. Study you formulas and make sure you measure correctly. Make sure that you take the correct equipment along ,and that you know how to use it. You must take the following into the final exam Paper 2: 30cm ruler, calculator, triangle, protractor, sharp pencil, string; you may also take magnifying glass. In this topic we will focus on the calculations part of Paper 2.

SECTION A: TYPICAL EXAM QUESTIONS: TOPIC 2

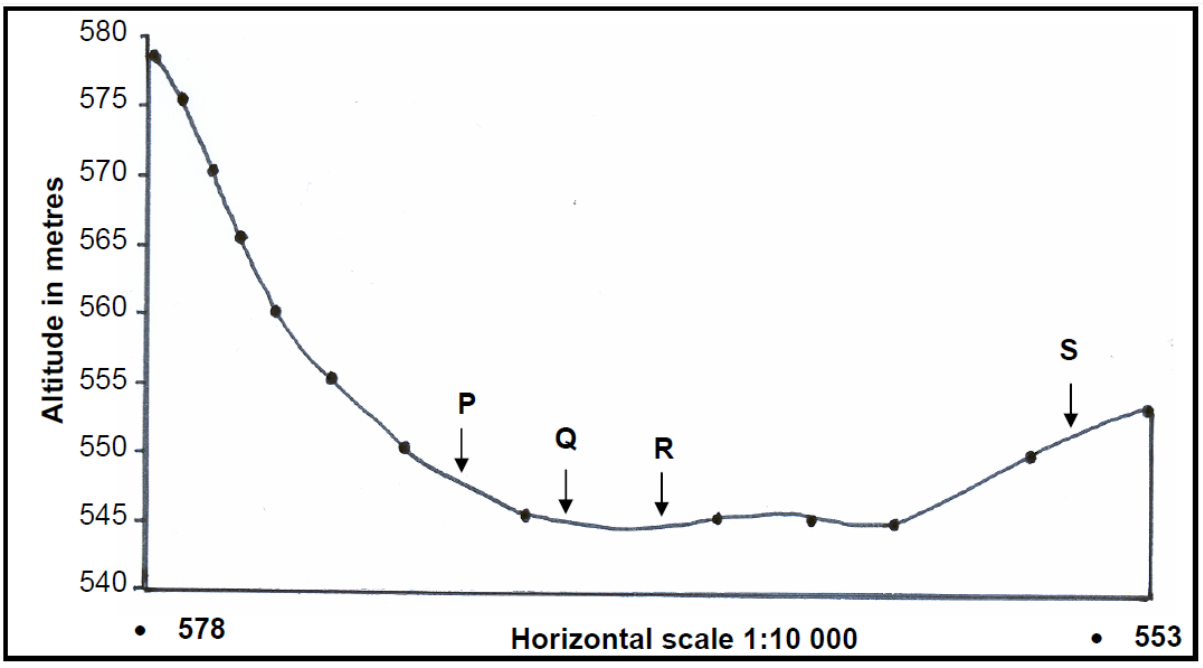
QUESTION 1: 45 minutes 37 marks *(Source: DoE Nov 2009 and March 2010)*

1.1 The diagram below is a cross-section from spot height 578 (A) to spot height 553 (B) on the orthophoto map.

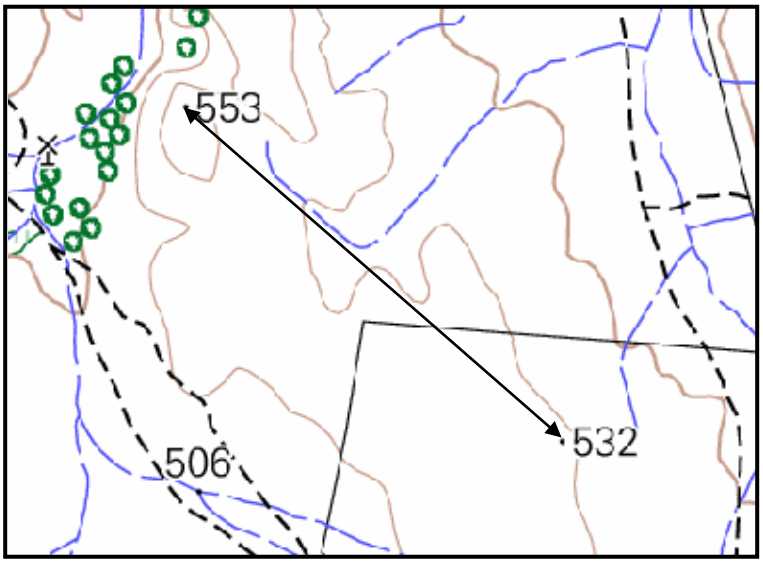
1.1.1 Are features P and R intervisible? (1)

1.1.2 Give ONE reason for your answer to QUESTION 1.1.1. (1)

1.1.3 Calculate the vertical exaggeration for the given cross-section. Show ALL your calculations. The vertical scale is 1cm: 5m and the horizontal scale is 1:50 000. (4)



1.2 Calculate the average gradient between spot height 532 (F3) and spot height 553 (E2) on the topographical map. Show ALL your calculations. (The distance should be 2.5cm but it can be wrong due to reduced notes.) (5)

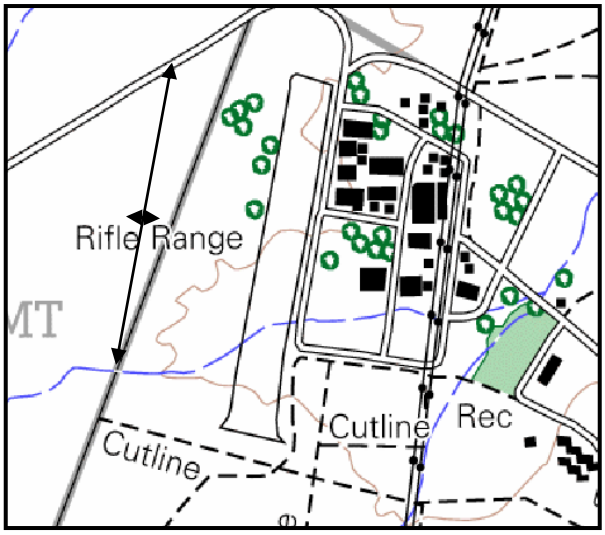


1.2.1. Would you consider the gradient that you have calculated in QUESTION 1.2. to be steep or gentle? (1)

1.2.2 Explain your answer to QUESTION 1.2.1. (2)

1.2.3 Give evidence from the topographical map to support your answer to QUESTION 1.2.2. (1)

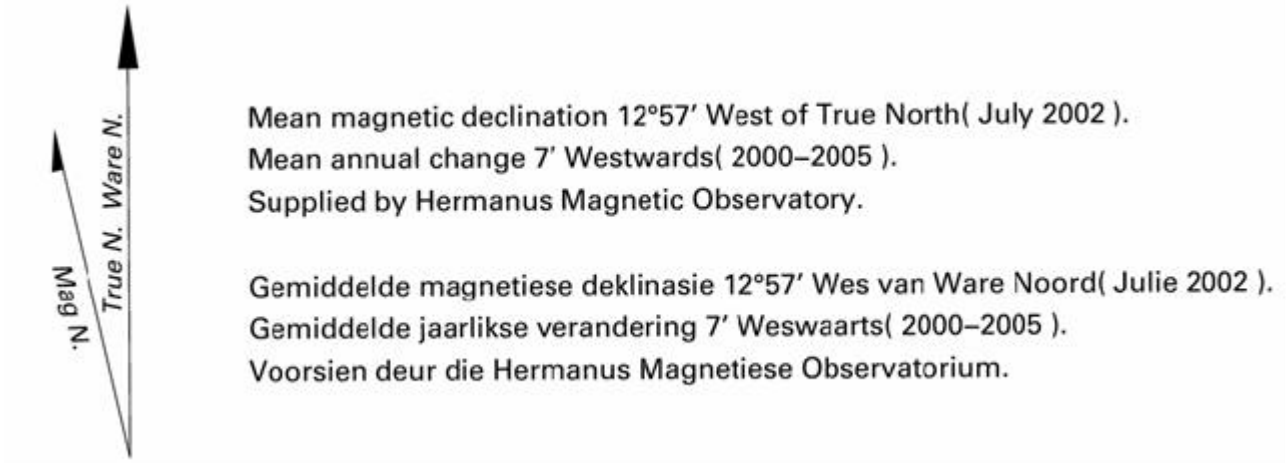
1.3. Calculate the area of the rifle range (E) on the map in km². Show ALL your calculations. (6)
(This calculation will only be correct if the length is 2cm on the notes)

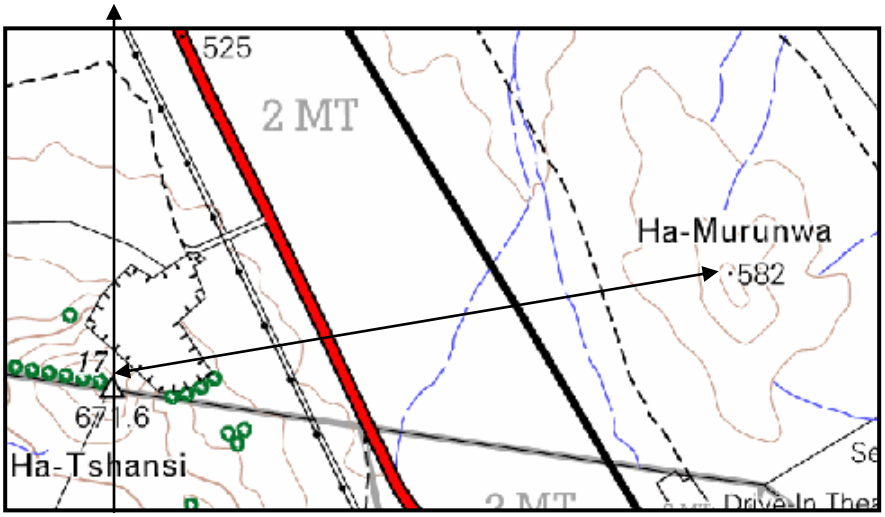


1.4. Determine the present magnetic bearing from trigonometrical station 17 (G1) to Spens Shaft (F5). Use the map clips that follow to do you measurements. (8)

Use the following steps as a guide:

Date of map:
Magnetic declination:
Mean annual change:
Difference in years:
Total annual change:
Magnetic declination in 2010:
True bearing:
Present magnetic bearing:

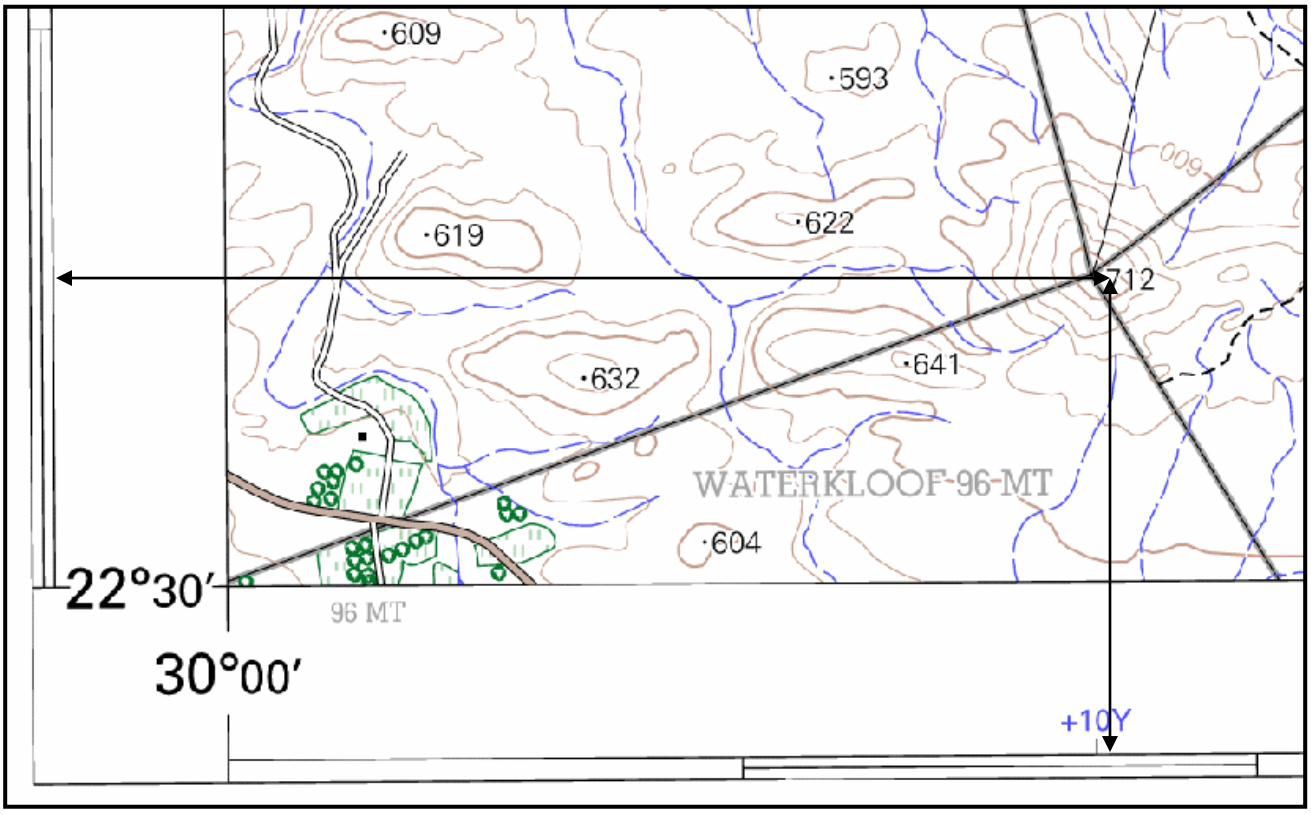




1.4.1. Which one, the topographical map or the orthophoto map, has a larger scale? (1)

1.4.2. Motivate your answer in 1.4.1. (3)

1.5. Give the co-ordinates (fix the position) of spot height 712. (4)



HINTS

Hint 1 – These answers count less than the rest of the mapwork or theory.
Hint 2 – Start with the formula and show all calculation – each step counts a mark.
Hint 3 – Make sure you have your own map work equipment and know how to use it
Hint 4 – Never leave out questions in this section – try at least
Hint 4 – Calculations is a practical skill – practice makes perfect

SECTION B: ADDITIONAL CONTENT NOTES

Map work formulas

28ºS

1. Map code: 2528AC Pretoria
   25: Latitude (South) 25ºE
   28: Longitude (East)
   A: Big block A
   C: Small Block B
   Pretoria: Settlement

A	B	A	B
C **A**	D	C **B**	D
A	B	A	B
C **C**	D	C **D**	D

2. Scale: Ratio scale 1: 50 000
Line Scale:
Word Scale: 1cm on the map represents 5km in reality

Large scale: reality not reduced so much 1: 10 000
Small scale: reality has been reduced a lot 1: 1 000 000

How to change distance units:

Km	hm	Dm	m	dm	cm	mm
1	10	100	1 000	10 000	100 000	1000 000
x multiply						y divide
0.000001	0.00001	0.0001	0.001	0.01	0.1	1

1mm = 0.1 cm
1cm = 10mm
1m = 1000mm

1km = 1 000 000mm
1km = 100 000cm
1km = 1000m

3. Distance: = map distance x scale *(50 000 on topographic map*
= 12.4cm x $\frac{50\,000}{100\,000}$ *or 10 000 or other on photo)*
(to change cm to km)
= 6.2km *(x 1 000 = 6200m)*

4. Area: = (map distance x scale) x (map distance x scale)
= (3cm x 0.5) x (6cm x 0.5) *(it will be different on photo)*
= 1.5 km x 3km *(never change km² to m² or vice versa)*
= 4.5km² (1500m x 3000m = 4 500 000m²)

5. Gradient: = $\frac{\text{Height}}{\text{Distance}}$ *(highest point – lowest point or contour)*
(calculated in m because height is in m)
= $\frac{1520\text{m} - 1480\text{m}}{1.6\text{cm} \times 500}$ *(altitude always in m on maps)*
(100 000 / 100 to cm to m)
= $\frac{40\text{m} \div 40}{800\text{m} \div 40}$ *(to get 1 because it is a ratio,*
it is not a fraction!)
= $\frac{1}{20}$ *(vertical)*
(horizontal
= 1: 20 *(1: 0 is a cliff, 1: 100 -gradual)*

6. Grid reference:

- ☺ Latitude always first: put the ruler horizontally over the map and read the latitude of the side. In SA this is always South.
- ☺ Longitude second: put the ruler vertically over the map and read the longitude at the top or bottom. In SA this is always East.
- ☺ 27º15, 2'S; 28º45, 8'E

7. Direction:

- ☻ We indicate the direction of rivers by identifying the direction that it flows toward.
- ☻ We name winds from where they come.

8. Magnetic declination:

2011	*(the present year)*
- 1990	*(the first year mentioned on the map)*
16years	*(time that has elapsed)*
x 10'East	*(the annual change on the map)*
160'E = 2º40'E	*(if it is >/= 60' change it to º and ')*
	(Read the mag. dec. from the map for 1990
21º12'W	*change it if it is 21,2ºW ☺ ,2 x 6 = 12')*
- 2º40'E	*(W+W; angle larger, W – E; angle smaller)*
18º32'W	*(Present magnetic declination – the*
	difference between North and mag. North)

9. Magnetic Bearing: = True bearing *(angle from True north on map)*
+ Magnetic declination (*calculated by you)*

MB = TB + MD
= 301º + 18º32' *(remember if it is larger than 180º add 180º*
= 319º32' *(leave out West, it is always clockwise from N)*

10. Vertical exaggeration: = Vertical scale *(given with Cross Section)*
Horizontal Scale *(map or photo scale)*

(First change the vertical scale that is usually in the form of a word scale to a ration scale.)

1cm: 20m *(20m x 100 to get cm)*
1cm : 2 000cm *(cancel same units)*
1: 2 000 *(ratio scale allow calculations)*

$$VE = \frac{VS}{HS} = \frac{\frac{1}{2\,000}}{\frac{1}{50\,000}} = \frac{1}{2\,000} \times \frac{50\,000}{1}$$

= the vertical scale is 25 times larger than the horizontal scale

11. Distance: = Speed x time

12. Speed: = Distance / Time

13. Time: = Distance / Speed

14. Photo scale: = Photo distance *(the same distance on map and photo)*
(Map distance x scale) or the distance in reality
= 10cm *(on photo)*
5cm x 50 000 *(distance calculation cm)*
= 10cm ÷ 10 *(to get 1)*
250 000cm ÷ 10 *(do the same below the line)*
= 1: 25 000 *(round off - no decimals)*

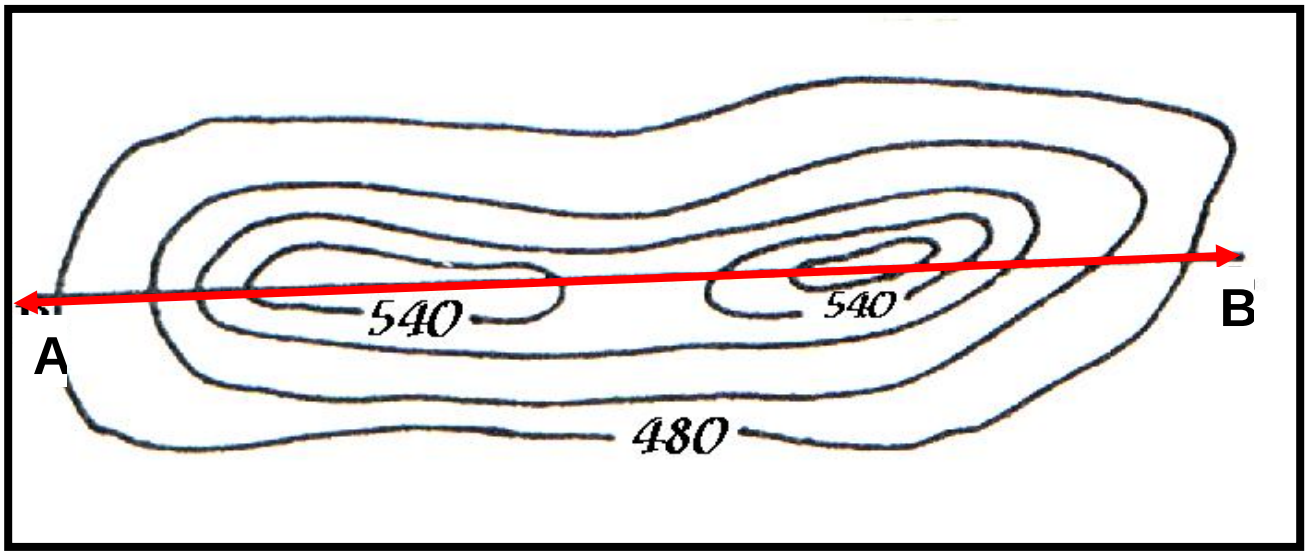
Map work improves with practice! Just keep on trying and you should succeed.

1. Introduction

We draw a cross section of the landscape to see what the relief or topography looks like. Distance on Earth is much more significant than altitude, and to show the altitude we need to exaggerate the vertical scale of the cross sections. This means we reduce distance more than height on the cross sections. You must also be able to draw a freehand cross section from looking at the contours, and then drawing the landform.
You can refer back to the unit on slopes and land forms in this module.

2. Drawing Cross Sections

Step 1



- **1**
  Locate the place from where and the place to where you must draw the cross section. (In this case From A to B)

- **2**

  Connect the 2 places with a pencil line and take paper (see green frame on map below) and put it from A to B along the line.

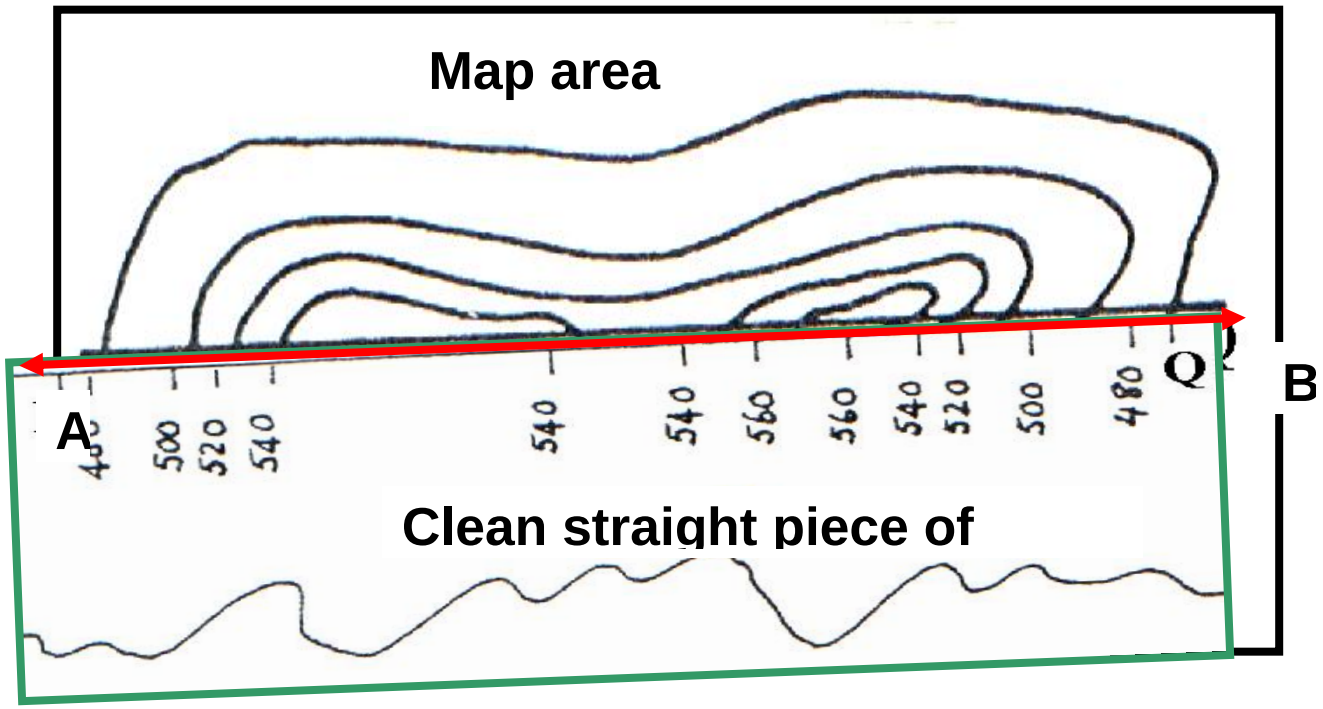
  - Mark off where any contour lines disappear under the paper.
  - Find the values of the contour lines you have marked. Look under the paper and further away to find the values of the contours. In this example all the values are under the paper. Compare the map above and below.

- **3**

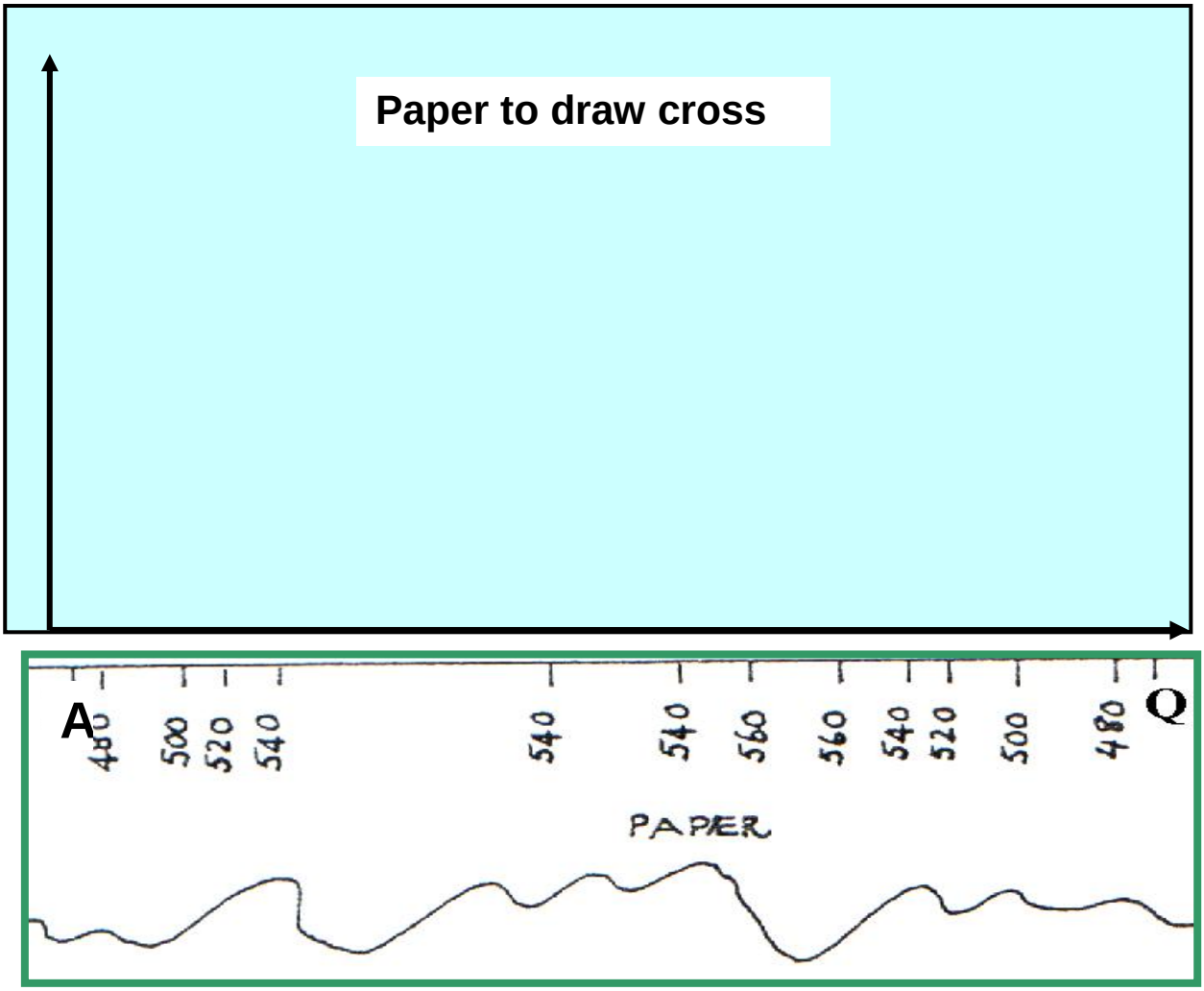
Then take the piece of paper and mark the contours and the values onto graph paper with a vertical axis (on the left of the paper) and a horizontal axis (at the bottom of the paper) already indicated on it.

- **4**
  - Add in the vertical scale which will be give to you in the form of a word scale or on a half completed cross section and the map scale as the horizontal scale.
  - Plot the values of the contours from the bottom of the sketch at the correct altitudes.
  - Connect the points with your freehand. (Never with a ruler)
  - Give the cross section a heading.

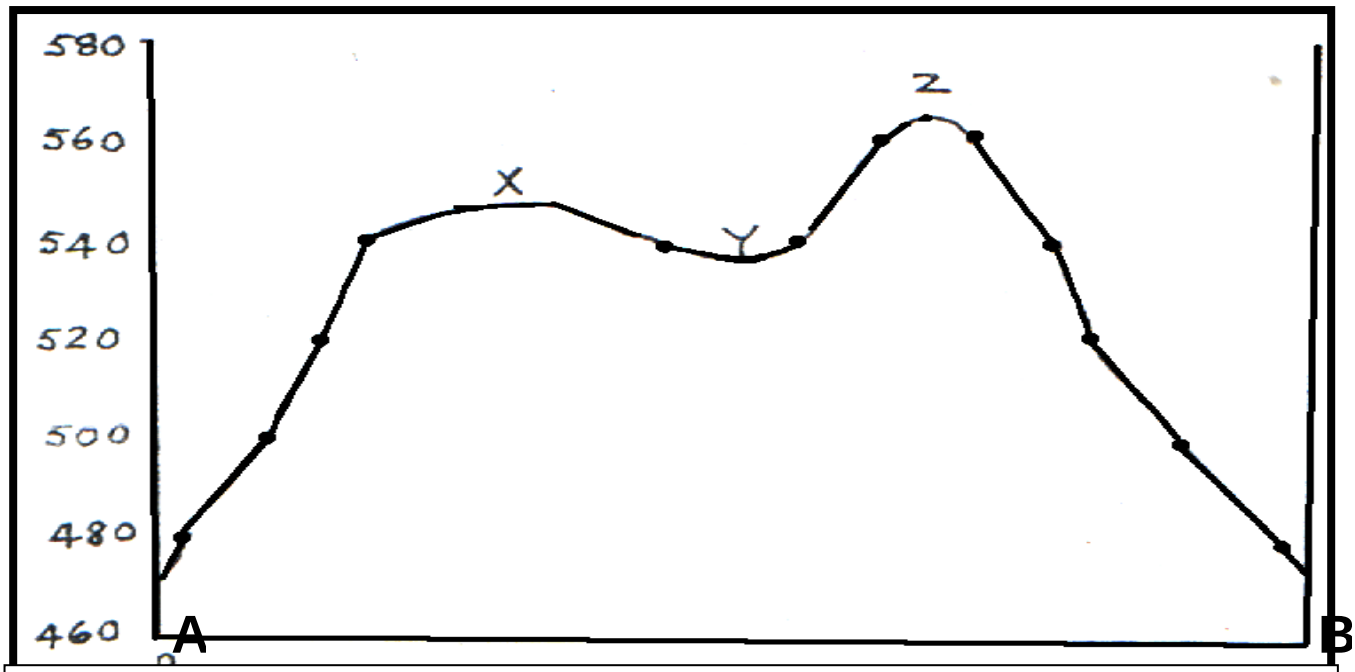
Step 2



Step 3


Paper to draw cross
A
480
500
520
540
540
540
560
560
540
520
500
480
Q
PAPER
B

Step 4: A cross section From A to B



Vertical scale 1cm : 10m **Horizontal scale 1: 50 000**

Use the map and the cross section to identify the landforms on the cross section. Land forms X and Z are peaks on the ridge or watershed. Y is a neck or a saddle.

Vertical exaggeration

Calculate how much larger is the vertical scale than the horizontal scale.
First change the vertical scale into a ratio scale.

1cm: 10 m (change the m to cm)
1: 1000 (if the units on either side of the scale are the same it can be cancelled)

Vertical exaggeration = $\frac{\text{Vertical scale}}{\text{Horizontal scale}}$

$= \frac{1/\ 1000}{1/\ 50\ 000}$

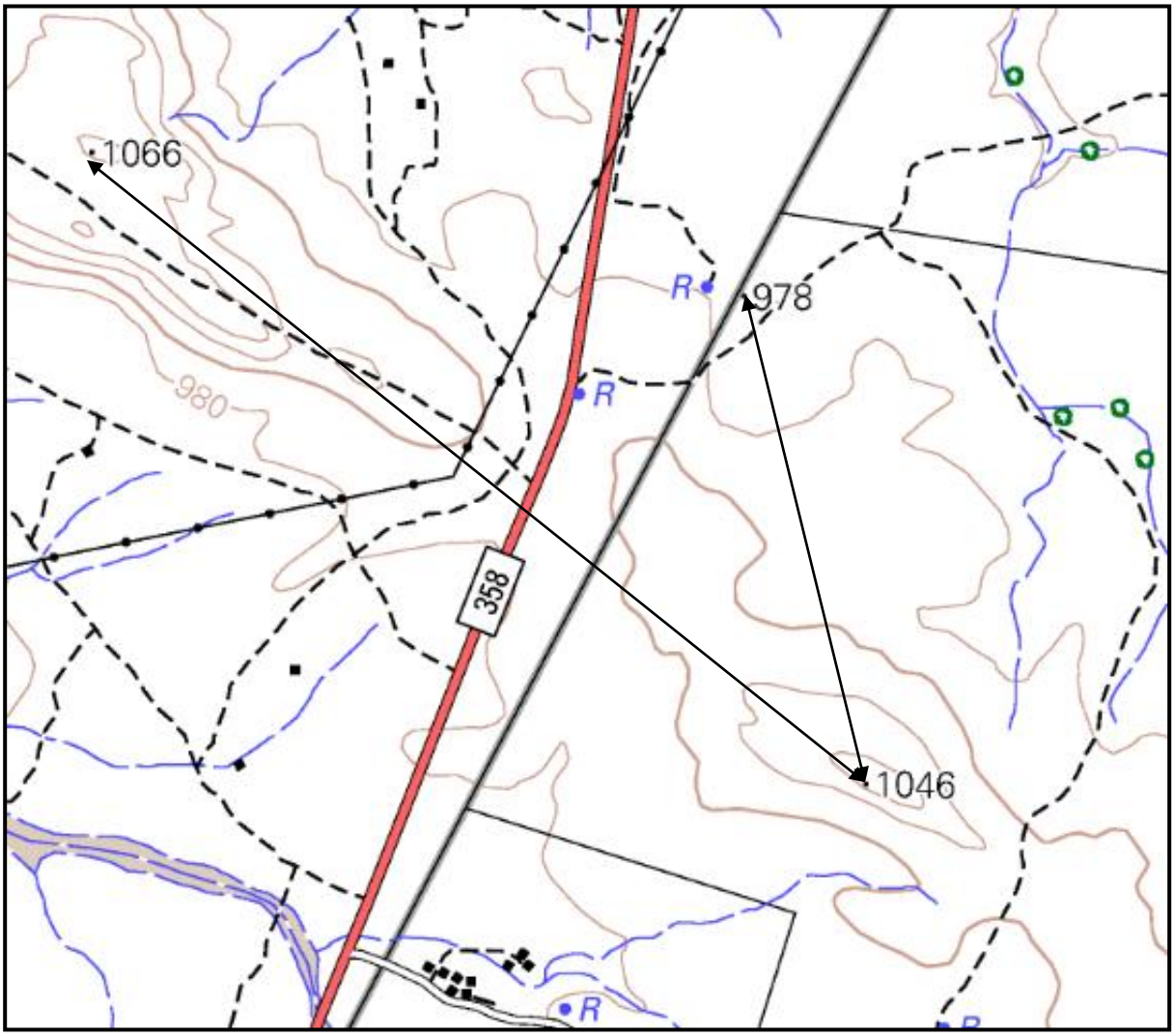
$= \frac{1}{1000} \times \frac{50\ 000}{1}$

$= 50$

(The vertical scale is 50 x larger than the horizontal scale)

SECTION C: HOMEWORK

QUESTION 1: 30 minutes 26 marks *(Source: Adapted from Nov.2008)*



1.1. Calculate the area covered by the map clip above if the scale is 1: 50 000 (4)

1.2. Calculate the gradient between spot height 978 and 1046. (5)

1.3.1. Draw an accurate cross section from spot height 1066 to 1046.
The vertical scale is 1cm represent 20m. (8)

1.3.2. Calculate the vertical exaggeration for the cross section (4)

1.3.3. Indicate the road and power line on the cross section. (2)

1.3.4. Identify the landform you have drawn on the cross section. (1)

1.3.5. Why does the road pass through this landform? (2)
[26]

SECTION D: SOLUTIONS AND HINTS TO SECTION A: TOPIC 2

QUESTION 1

1.1.1. Yes ✓ (1)

1.1.2. No high-lying ground/obstructions between the two given points ✓ (1)
[Concept]

1.1.3. Vertical exaggeration = $\frac{\text{vertical scale}}{\text{Horizontal scale}}$ ✓

$= \frac{1:500}{1:10\,000}$ ✓

$= \frac{1}{500} \times \frac{10000}{1}$ ✓

= 20 times larger than horizontal scale ✓ (4)

1.2.1. Vertical Interval/Rise/Distance = 553 m - 532 m 21 m ✓

Horizontal Equivalent/Distance/Run = 2,5 cm x 500 (range: 2,4 cm – 2,6 cm)

= 1 250 m✓ (Answer must be in meters)

[Accept any other method to calculate distance. Actual marks for measurement and answer.]

Gradient = $\frac{\text{Vertical Interval}}{\text{Horizontal Equivalent}}$ ✓

$= \frac{21m \div 21}{1\,250 \div 21}$ ✓

= 1/ 1:59,52 ✓ (Range: 57 – 62)

[ONLY answer give FULL marks. If answer is incorrect, mark steps.] (5)

1.2.2. No✓ (1)

1.2.3. You need to move 59.52 m✓ horizontally to rise with 1m. ✓ (2)

1.2.4. Contours are far apart✓ (1)

1.3. Length = 2 x 0,5 (range: 1,9 cm – 2,1 cm) ✓
= 1 km✓
Breadth = 0.6 x 0,5 (range: 0.5 cm – 0.7cm) ✓
= 0,12 km ✓
Area = 1 km x 0,12 km ✓
= 0,12 km²
(Range: 0,11 km2 - 0,13 km²) ✓ (6)

1.4. Date of map: 2002 ✓
Magnetic declination: 12°57'W ✓
Mean annual change: 7'W ✓
Difference in years: 9 years ✓
Total annual change: 63'W ✓
Magnetic declination in 2010: 14°W ✓
True bearing: 79° - 81° ✓
Present magnetic bearing: 93°– 95°✓ (8)

1.4.1 Orthophoto map ✓ (1)

1.4.2 Orthophoto map shows more detail ✓
Smaller area shown on a large piece of paper ✓
Greater clarity on orthophoto map ✓
1:10 000 is a larger scale than 1:50 000 ✓ (3)

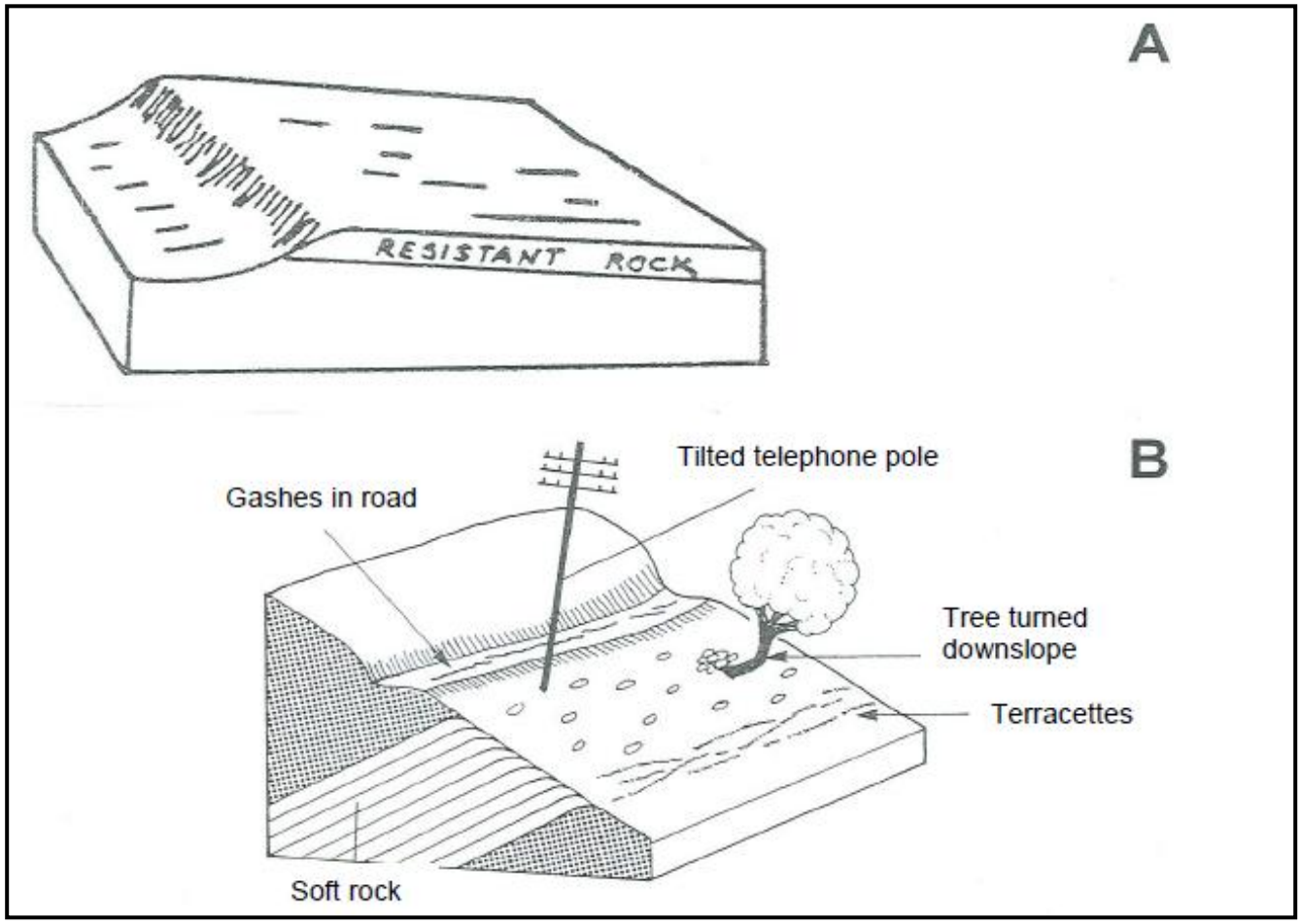
1.5 22°29'26''S ✓ ✓ 30°01'42''E ✓✓ (4)
OR
22°29,4'S ✓ ✓ 30°01,7'E✓ ✓ **[37]**

TOPIC 1: STRUCTURAL LAND FORMS

Learner Note: This is often asked with reference to sketches and sketch maps. This work occurs in every exam paper. It is a good investment to study it well. The questions are often asked in combination with other parts of the geomorphology or even climate information. This requires you to be able to interpret the work in a new situation.

SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: **20 minutes** **24 marks** *(DoE Exemplar 2008)*



1.1 FIGURE A above shows a landform typically found in South Africa. FIGURE B shows the process of mass movement that will take place on the slopes of the illustrated landform.

(a) Identify the landform (feature) illustrated in FIGURE A. (1 x 2) (2)

(b) Explain, with reference to the underlying rock structure, how the landform identified in QUESTION 1(a), developed. (3 x 2) (6)

1.2 (a) What type of mass movement is illustrated in FIGURE B? (1 x 2) (2)

(b) Provide evidence from FIGURE B that mass movement is taking place. (1 x 2) (2)

(c) On which slope, the dip slope or the scarp slope, is mass movement more likely to take place? (1 x 2) (2)

(d) Explain your answer to QUESTION 1.2(c). (2 x 2) (4)

(e) Why do you think people should be made aware of the consequences of mass movement before building on slopes? (2 x 2) (4)

(f) Name ONE way in which slopes can be stabilised (reinforced) to reduce mass movement. (1 x 2) (2)

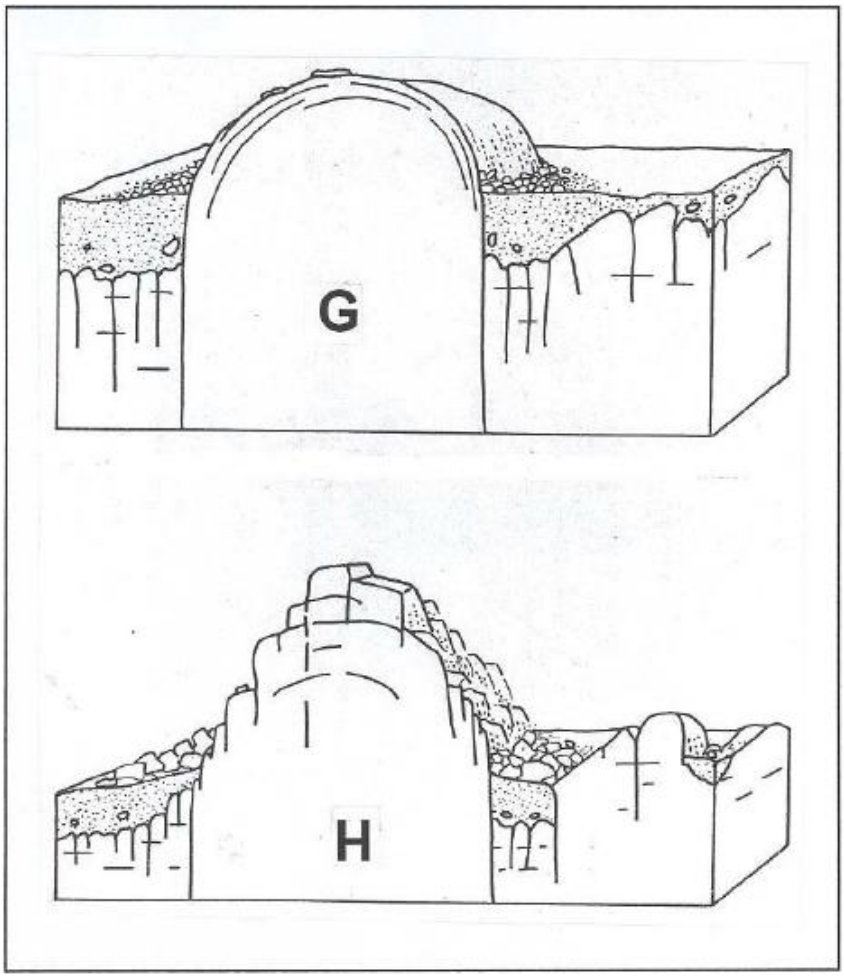
[24]

HINTS

Hint 1 – Look at the angle of inclination on the sketch; in this sketch it is less than 25°

Hint 2 – Know the sketches and definitions very well.

QUESTION 2: 15 minutes 22 marks *(Source: DoE March 2009)*



2. The FIGURE above illustrates the development of a structural landform associated with massive igneous rock.

2.1 Identify the landforms labelled G and H respectively. (2 x 2) (4)

2.2 Name the original underground igneous landform from which landforms G and H originated. (1 x 2) (2)

2.3 Briefly explain how landform H develops. (3 x 2) (6)

2.4 Briefly explain how landform G develops. (3 x 2) (6)

2.5. What drainage pattern will develop on landform G? (1 x 2) (2)

2.6. Explain why the drainage pattern you have identified in 1.5 will develop at G. (1 x 2) (2)

[22]

QUESTION 3: 10 minutes 16 marks *(Source: DoE Nov 2010)*

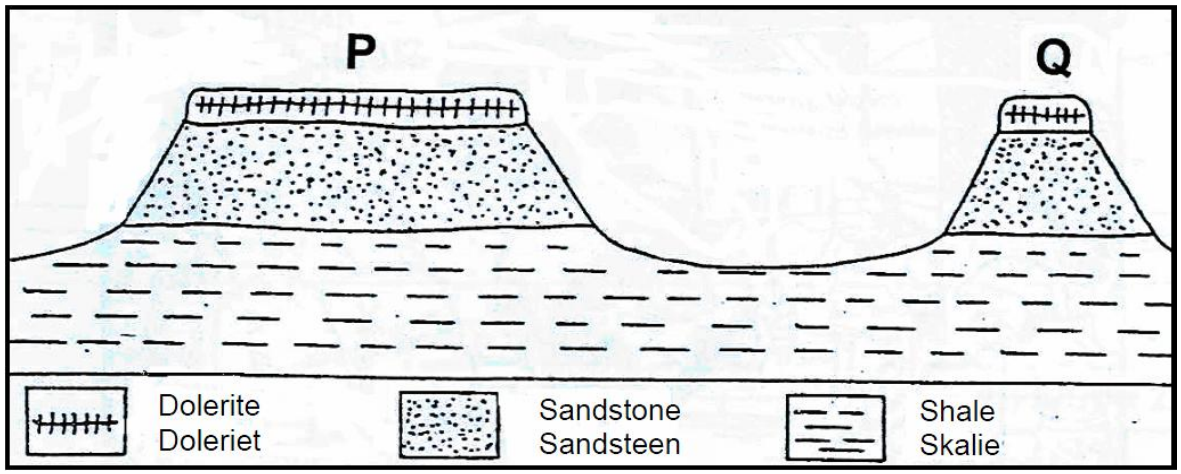


FIGURE 3

3. FIGURE 3 above illustrates a structural landscape typically found in the Karoo.

3.1 Identify landforms **P** and **Q** respectively. (2 x 2) (4)

3.2 What evidence in the FIGURE 3 suggests that landforms **P** and **Q** developed from the same landform that existed earlier? (2 x 2) (2)

3.3 Which rock type in the FIGURE 3 is the most resistant to erosion? (1 x 2) (2)

3.4 Give ONE reason for your answer to QUESTION 3.3. (1 x 2) (2)

3.5 Briefly describe how landform **P** will change into landform **Q**. (3 x 2) (6)

[16]

QUESTION 4: 10 minutes 16 marks (*Source: DoE March 2010)*

4. Refer to the figure below showing the development of a landscape associated with horizontal sedimentary rock. The three diagrams are not arranged in the correct order of development.

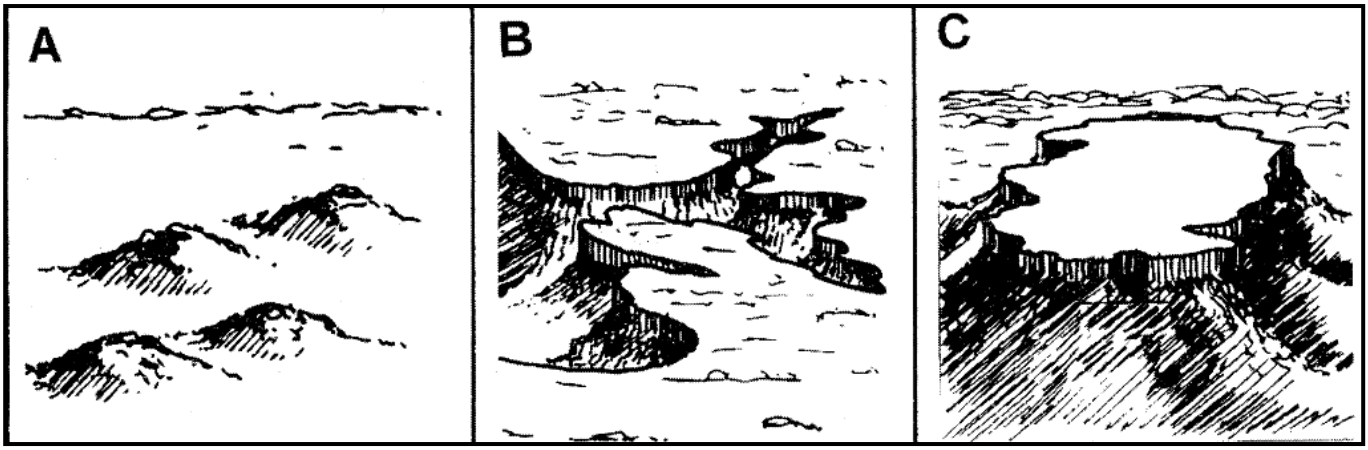
4.1 Arrange the three diagrams in the correct order of development by writing the letters that appear on the diagrams in the correct order. (3 x 2) (6)

4.2. The utilisation of landscape B by humans is limited. Explain the reason for this. (2 x 2) (4)

4.3. Which ONE of the diagrams illustrates a typical Karoo landscape? (1 x 2) (2)

4.4. Identify the landform in the diagram mentioned in QUESTION 4.3, that is typically found in the Karoo landscape. (1 x 2) (2)

4.5. Give a reason why cuestas will not develop in the landscape visible in the figure below: (1 x 2) (2)
[16]

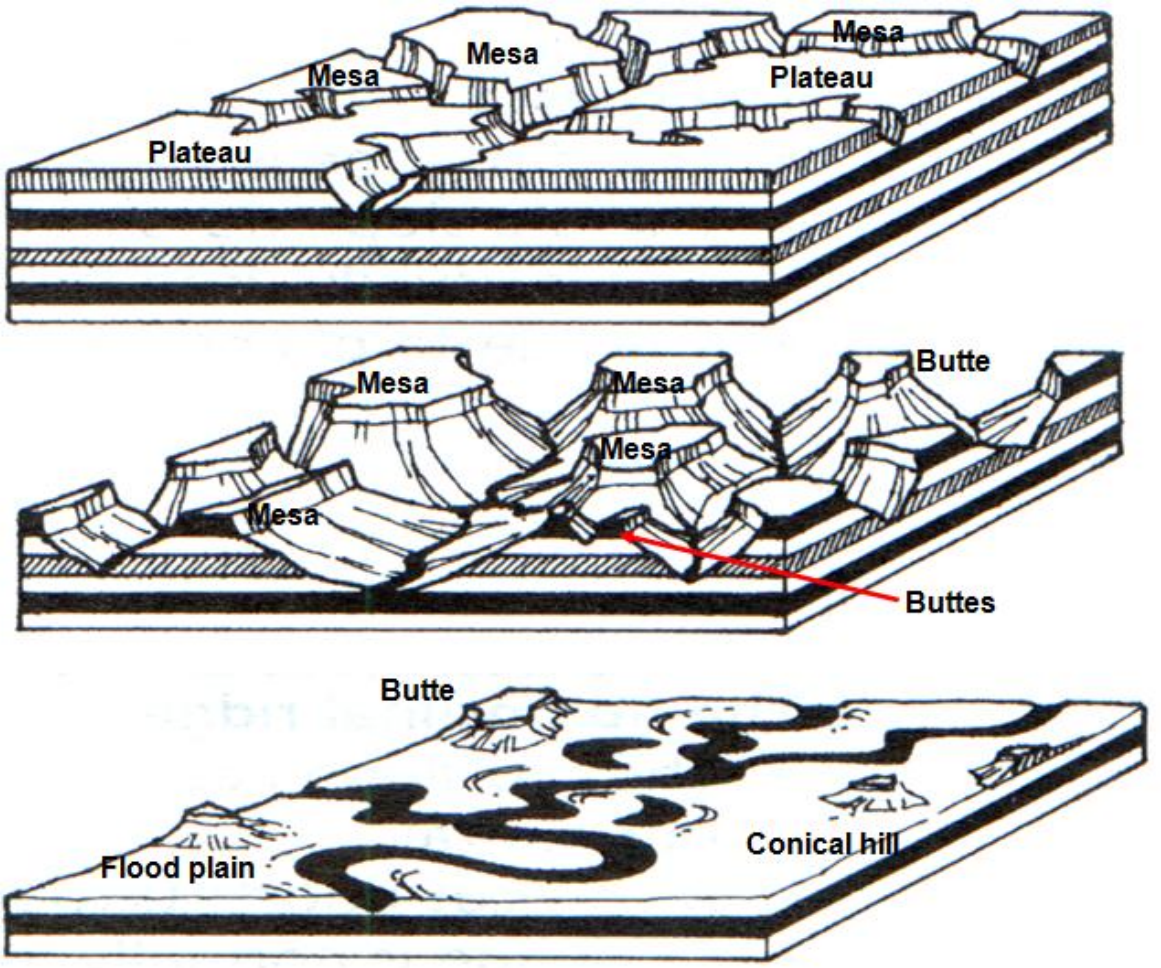


SECTION B: ADDITIONAL CONTENT NOTES

TOPOGRAPHY OF HORIZONTAL STRATA

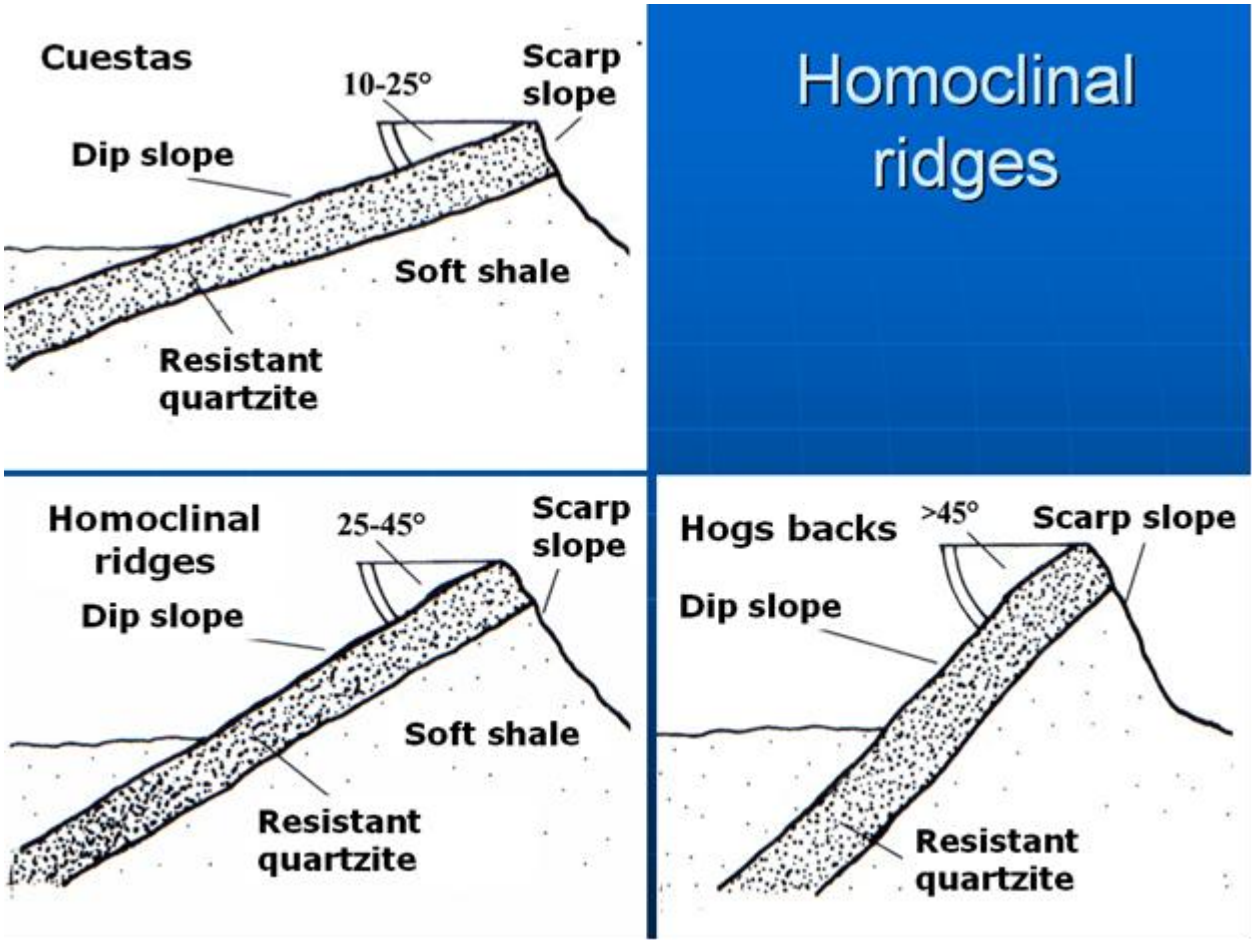
- Sedimentary rock with igneous sills that are horizontal to the surface.
- Harder sills prevent erosion and form flat tops of landscapes, e.g. the Basaltic plateau of Lesotho.
- Plateaus are cut smaller into mesas, buttes and, when the hard layers are removed completely, conical hills.
- In dry areas where exotic rivers occur, canyons develop due to the dominance of stream erosion and the absence of sheet erosion.
- In areas with uniform rock, hilly landscapes will develop like the badlands in North America.

A plateau is cut down into mesa, mesas are cut into buttes, and buttes become conical hills. The plateau is changed into a plain.

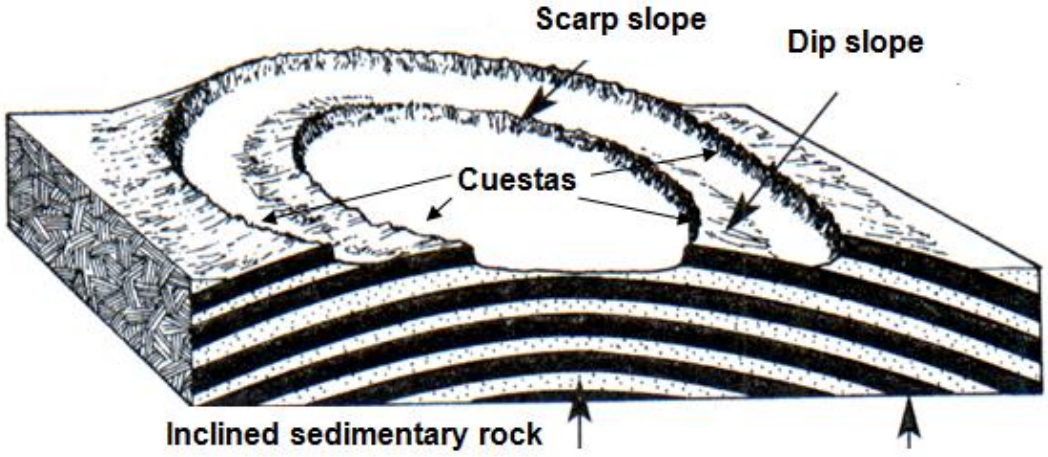


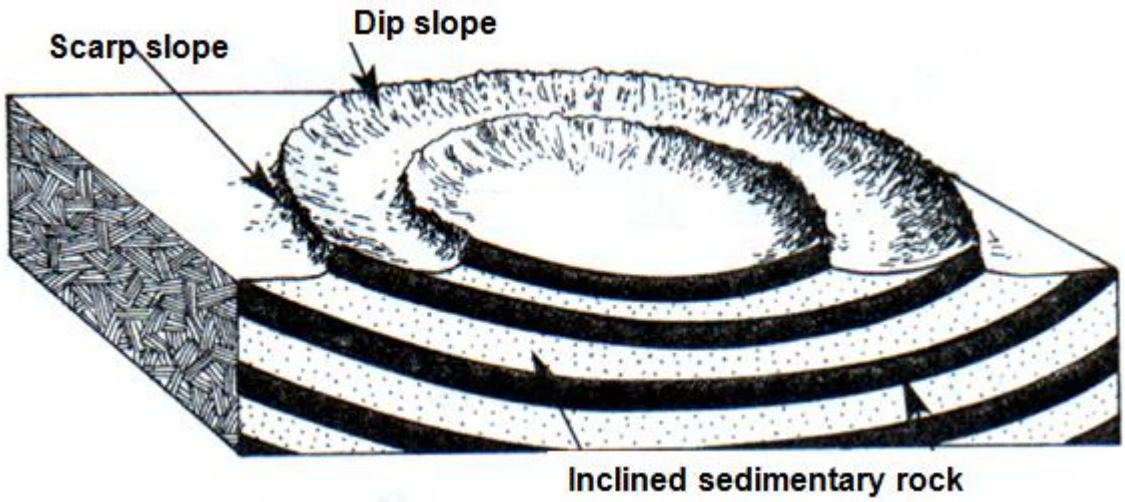
LANDFORMS ASSOCIATED WITH INCLINED ROCK STRATA.

- Rock has been bent or inclined due to pressure in the crust or igneous intrusions.
- The inclined rock consists of sedimentary and metamorphic rock.
- When homoclinal ridges develop, they always have a dip and a scarp slope on either side.
- The gradient of the angle of inclination determines the landform:
  1. Cuestas – inclined between 10º and 25º,
     Steep scarp slope and gradual dip slope.
  2. Homoclinal ridges – inclined 25º - 45º,
     Dip slope not so gradual and scarp slope steeper.
  3. Hogbacks – Inclined > 45º,
     Dip and scarp slope nearly the same.
- Erosion takes place faster along the steep scarp slope and towards the dip slope, because the scarp slope is steeper and some of the softer rock is exposed along the scarp slope.



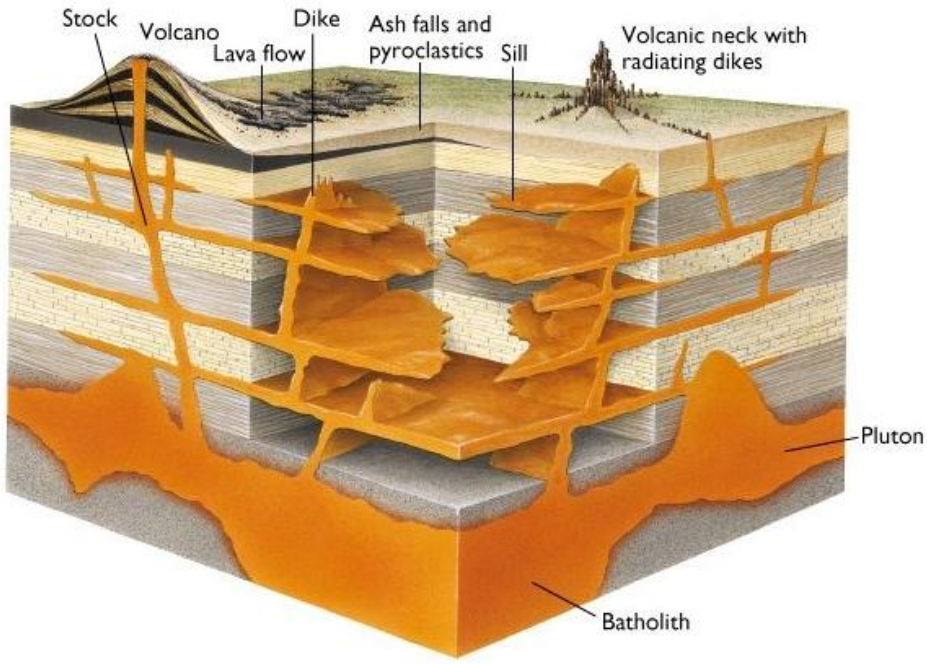
Where layers have been bent in concentric circles like the next two sketches, homoclinal ridges will form as the layers are eroded.





Volcanic intrusions: igneous rock cool down in the crustal layers or earth.

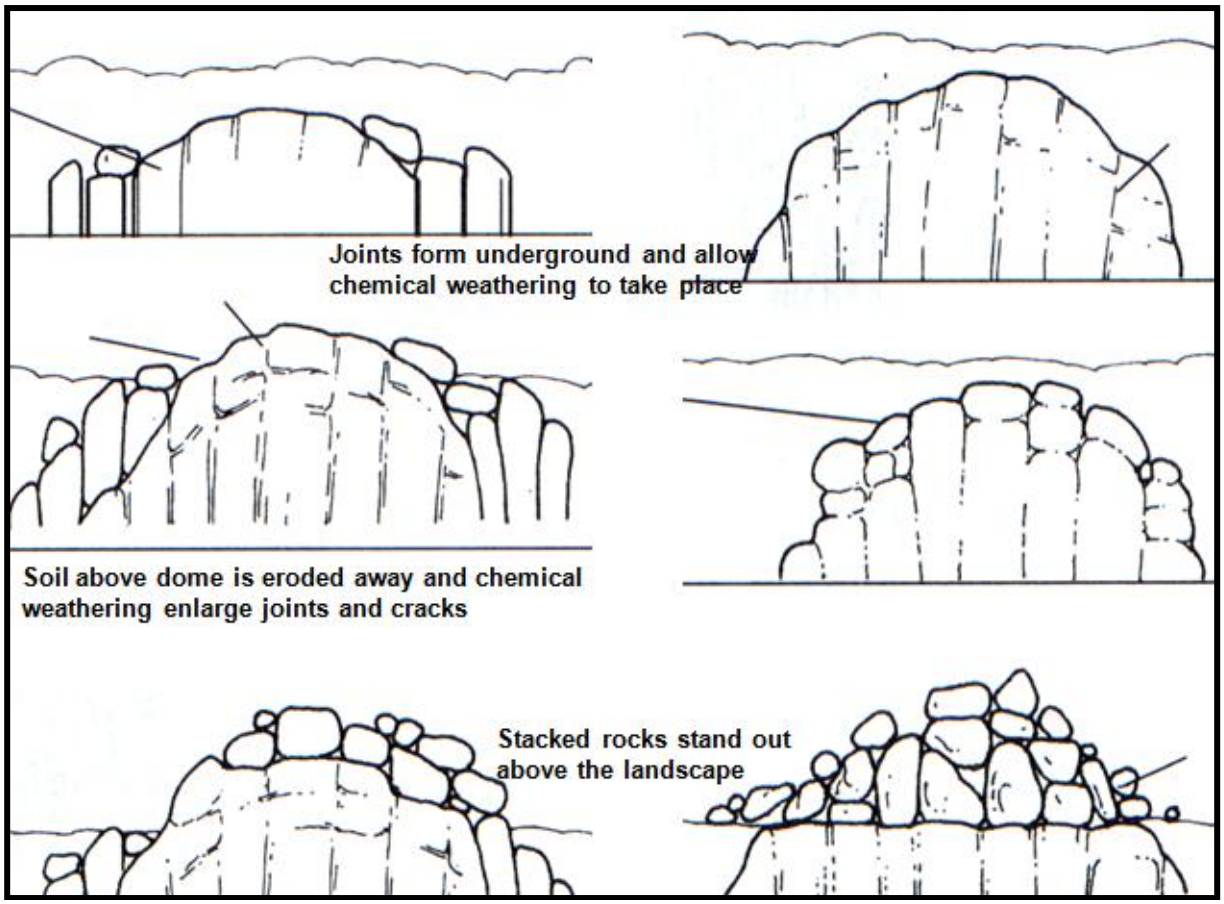
Types of Igneous Structures



Batholith	Large mass of igneous rock that solidifies deep under the surface in a dome shaped intrusion
Sill	Layer of igneous rock that solidifies parallel and horizontal with sedimentary rock
Dyke	Igneous rock solidifies in a fissure, cutting vertically through the existing rock layers
Lopolith	A saucer shaped igneous intrusion that form deep under the surface and bends the layer below it down
Laccolith	A mushroom shaped igneous intrusion which forms near to the surface and bends the layers above it upward
Pipe	Cylindrical intrusion through which magma is pushed to the surface

LANDFORMS ASSOCIATED WITH IGNEOUS INTRUSIONS

- Igneous intrusions form when magma solidifies amongst sedimentary and metamorphic rock, e.g. Batholiths, sills, dykes, laccoliths, Lopolith and pipes.
- Exfoliation domes form when large pieces of granite is exposed to the surface, and rounded by exfoliation due to temperature changes.
- Tors form when the granite dome is jointed under the surface, and chemical weathering enlarges the joints and cracks. When the granite is exposed to the surface, all the weathered material is eroded away and a stack of boulders are left on the surface.



SECTION C: HOMEWORK: TOPIC 1

QUESTION 1: 10 minutes 16 marks *(Source: DoE Nov 2009)*

Refer to the FIGURE A and B below showing a landscape typical of inclined sedimentary layers. FIGURE B illustrates a drainage pattern that will most likely develop in the landscape shown in FIGURE A.

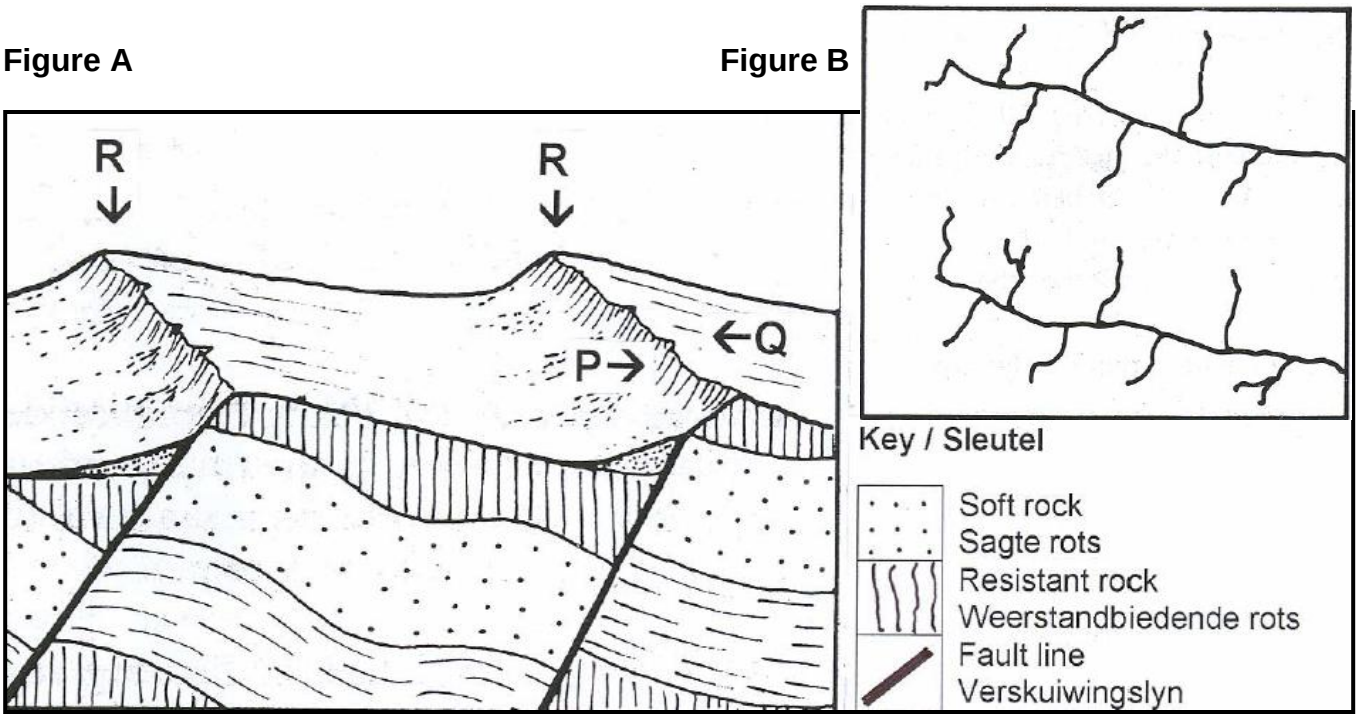
1.1. Name the landforms labelled R in FIGURE A. (1 x 2) (2)

1.2. Briefly describe the development of the landscape illustrated in FIGURE A. (3 x 2) (6)

1.3. Name the drainage pattern illustrated in FIGURE B that will develop in the landscape shown in FIGURE A. (1 x 2) (2)

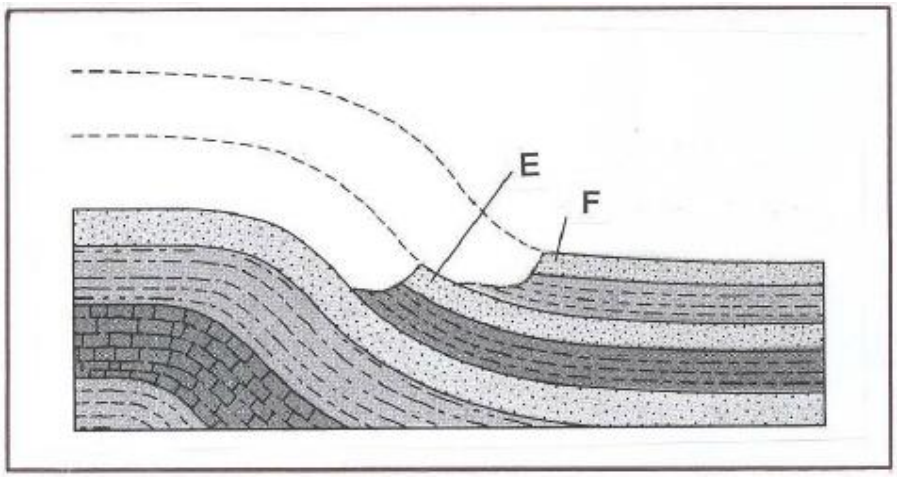
1.4. Explain why the drainage pattern mentioned in QUESTION 1.3 will develop in this landscape. (3 x 2) (6)

Figure A **Figure B**



[16]

QUESTION 2: **5 minutes** **10 marks** *(Source: DoE March 2009)*



2. Rocks have different types of strata which give rise to unique landforms. Use the figure above to observe some of these landforms and answer the questions that follow.

2.1 Identify the features (landforms) labelled E and F. (2 x 2) (4)

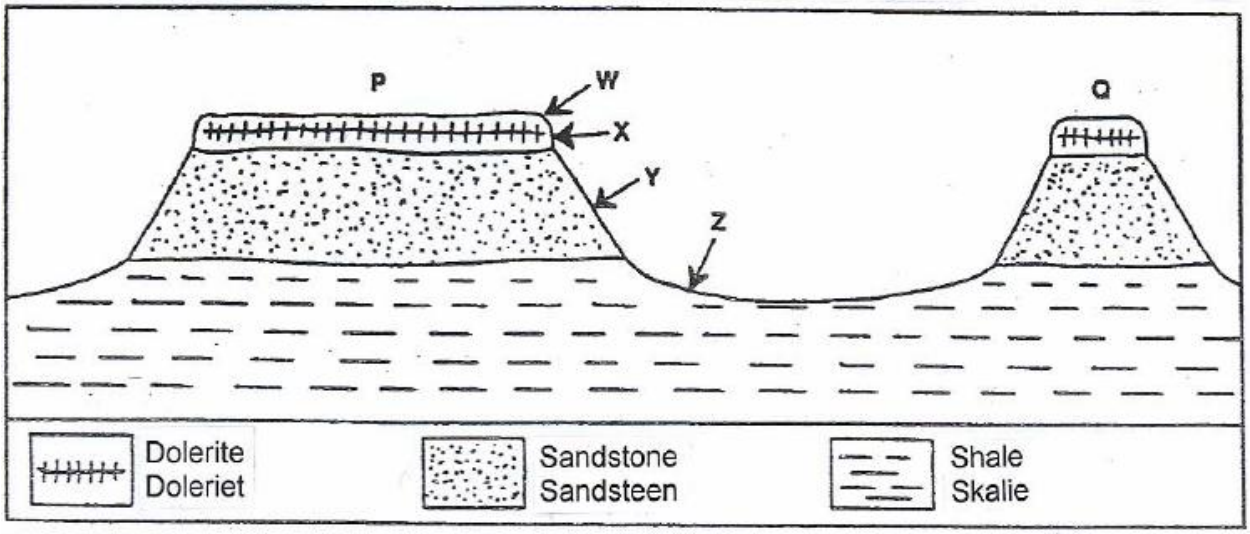
2.2 Give ONE difference between feature (landform) E and F. (1 x 2) (2)

2.3 Of what value is this landscape to man? Give TWO reasons. (2 x 2) (4)

[10]

QUESTION 3: 5 minutes 10 marks *(Source: DoE March 2009)*

3.1. Refer to the FIGURE below showing a landscape found in South Africa. Four options are provided as possible answers to the following questions. Choose the answer and write only the letter (A – D) next to the question number.



3.1 The landscape illustrated in the figure above is associated with … rock.

A massive igneous
B horizontal sedimentary
C tilted igneous
D tilted sedimentary

3.2 Landform P is a …

A mesa.
B cuesta.
C butte.
D tor.

3.3 Slope element Z is the …

A crest.
B cliff.
C talus.
D pediment.

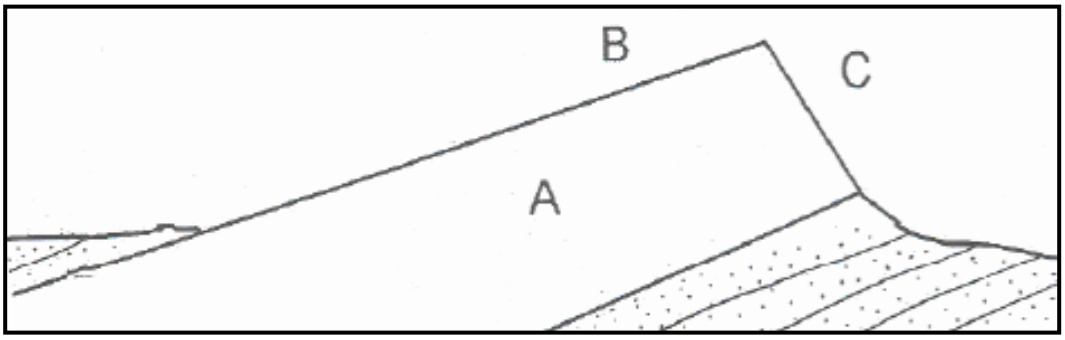
3.4 The landscape is typical of … regions in South Africa.

A humid and hot
B dry and hot
C humid and cold
D dry and cold

3.5 The landscape is typical in …

A Mpumalanga.
B KwaZulu-Natal.
C the Northern Cape.
D Gauteng. (5 x 2) [10]

QUESTION 4: 10 minutes 16 marks *(Source: DoE September 2008)*



4 Refer to the figure above showing a ridge labelled A.

4.1 (a) Identify the ridge labelled A. (1 x 2) (2)
(b) State ONE significance of ridge A to humans. (1 x 2) (2)
(c) Briefly explain the formation of ridge A. (3 x 2) (6)
4.2 Identify slopes B and C respectively. (2 x 2) (4)
4.3 Mesas will not develop in this landscape. Give a reason why this is so. (1 x 2) (2)
[16]

HINTS
Hint 1- Keep the mark allocation in mind when you answer questions.
Hint 2 - You must be able to identify features from sketches and then describe how they form and how they change.

SECTION D: SOLUTIONS AND HINTS TO SECTION A: TOPIC 1

QUESTION 1

1.1 (a) Cuesta/Homoclinal ridge ✓✓ (1 x 2) (2)
(b) Sedimentary rock layers tilted ✓✓
Rock layers vary in resistance ✓✓
Rock layers exposed to the Earth's surface ✓✓
Soft rock erodes away to form valleys ✓✓
Hard rock protrudes above surface to form ridges ✓✓ [Any THREE] (3 x 2) (6)

1.2 (a) Soil creep ✓✓ (1 x 2) (2)
(b) Tilted telephone pole ✓✓
Gashes in the road ✓✓
Tree turned down slope ✓✓
Terracettes formed on slope ✓✓ [Any ONE] (1 x 2) (2)

(c) Scarp slope ✓✓ (1 x 2) (2)

(d) Steeper slope ✓✓
Stronger influence of gravity ✓✓
Material more easily moved down the slope ✓✓ [Any TWO] (2 x 2) (4)

(e) Buildings can be destroyed ✓✓
Roads can be destroyed ✓✓
Damage to buildings and roads could be costly ✓✓
To take proper precautions before building ✓✓
[Any TWO – Accept other] (2 x 2) (4)

(f) Cover slopes with dense vegetation to stabilise the soil ✓✓
Safety nets to catch falling materials ✓✓
Lay down mesh wire to stabilise the soil ✓✓
Create rock embankments to prevent movement down the slopes ✓✓
Build ''undercover'' roads (tunnels) to protect vehicles ✓✓
Do proper environmental impact assessment ✓✓ [Any ONE] (1 x 2) (2)
[24]

QUESTION 2

2.1 G Dome ✓✓
H – Tor ✓✓ (2 x 2) (4)

2.2 Batholith/Laccolith ✓✓ (1 x 2) (2)

2.3 Batholith crack as weight on it is released due to weathering of rock and soil on top of it. ✓✓
Chemical weathering along cracks as ground water infiltrate cracks ✓✓
Rock mass exposed to Earth's surface ✓✓
Weathered material removed through erosion ✓✓
Rounded core stones remain behind ✓✓
[Order is important -Any THREE] (3 x 2) (6)

2.4 Batholith is exposed to surface due to erosion of softer rock and soil around it ✓✓
Dome is rounded by exfoliation of uneven parts on dome ✓✓
Dome stand out as one solid mass of igneous rock ✓✓ (3 x 2 (6)

2.5. Radial drainage pattern ✓✓ (1 x 2) (2)

2.6. Water will drain from the highest point in the middle of the dome in all directions as it is lower in all directions. ✓✓ (1 x 2) (2)
[22]

QUESTION 3

3.1 P – mesa/table mountain ✓✓
Q – Butte ✓✓ (2 x 2) (4)

3.2 They are joined at the base with shale rock ✓✓
They have same rock layers ✓✓
They have the same height and depth ✓✓
Both have same original height/cap rock ✓✓ [Any ONE] (1 x 2) (2)

3.3 dolerite/igneous ✓✓ (1 x 2) (2)

3.4 Back-wasting is taking place not downward wasting/downward erosion ✓✓
It is a hard layer of rock that caps (protects) P and Q ✓✓
Original height maintained ✓✓ [Any ONE] (1 x 2) (2)

3.5 Cap rock/igneous sill/dolerite reduced from the sides ✓✓
P reduces in size due to erosion by running water ✓✓
P reduces through rock falls ✓✓
Back-wasting occurs ✓✓
Slope retains the height ✓✓
Parallel retreat of slopes ✓✓
Eventually height of feature is greater than diameter ✓✓
[Any THREE] (3 x 2) (6)
[16]

QUESTION 4

4.1. B ✓✓- C ✓✓- A ✓✓ [Must be in correct order] (3 x 2) (6)

4.2 The landscape is arid ✓✓
Coarse grained infertile soil ✓✓
Narrow floodplain ✓✓
River flows in deep, steep sided valley ✓✓
Not suited for agriculture ✓✓
Not suited for settlement ✓✓
Development of infrastructure is limited ✓✓
Only suitable for adventure tourism ✓✓
[Any TWO] 2 x 2) (4)

4.3 C ✓✓ (1 x 2) (2)
4.4 Mesa ✓✓ (1 x 2) (2)
4.5 Because it is horizontally layered ✓✓ (1 x 2) (2)
[16]

TOPIC 2: MAP INTERPRETATION CLIMATE / GEOMORPHOLOGY

Learner Note: Map interpretation counts 40 of the 100 marks for Paper 2

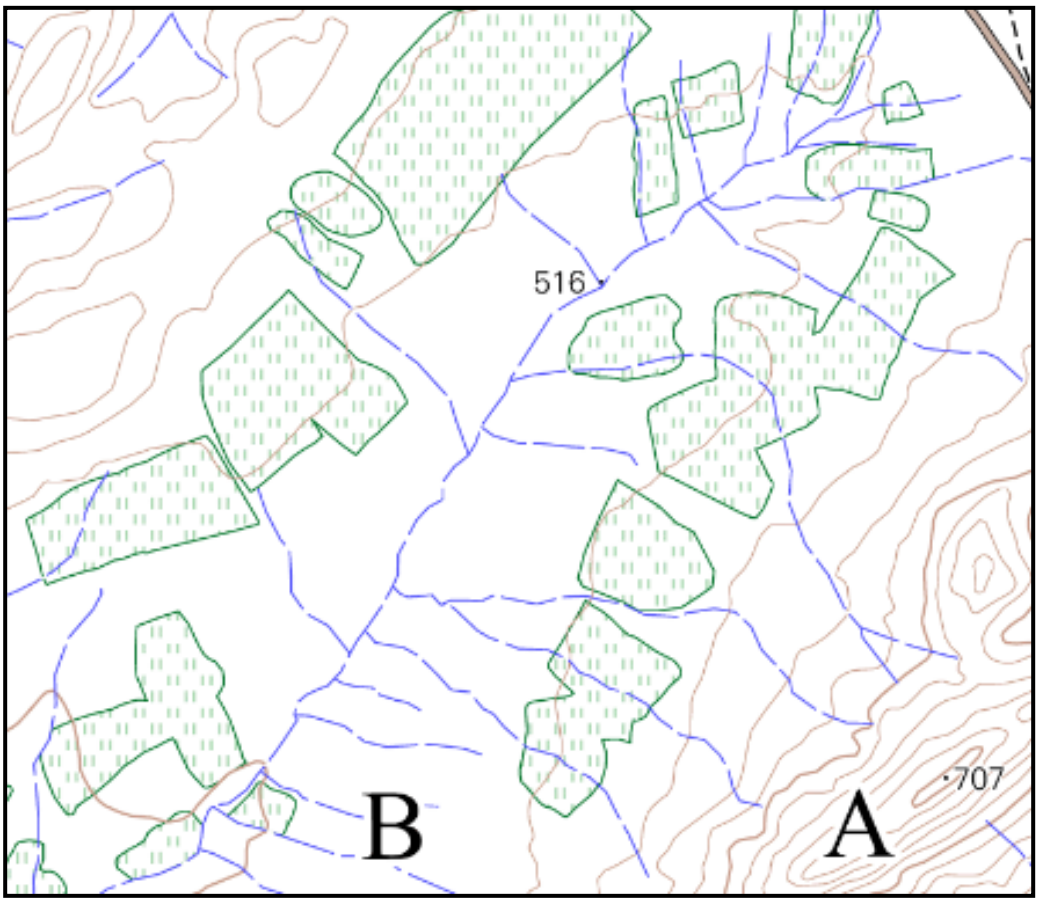
Map interpretation means that you must be able to take what you have learnt in the other chapters of the subject, and apply it on a map. You must also be able to look at the map and the symbols that represent features on earth and understand what the relationship between these features are. For this topic we will focus on the theory chapters that we have completed so far for the map interpretation section, namely Climatology and Geomorphology.

There is no calculation required for this section. Bear in mind that the scale of the map clips is not correct due to enlarging and reducing for clarity and the sake of printing.

SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: 45 minutes 52 marks *(Source: DoE Nov 2009 & March 2010)*

1. The map clips were taken from the AA&AC Musina map. Map Clip 1



1.1.1. Identify the drainage pattern assumed by the river system in these two blocks. (1 x 2) (2)

1.1.2. With reference to the topographical map, explain why the river system assumed this drainage pattern (2 x 2) (4)

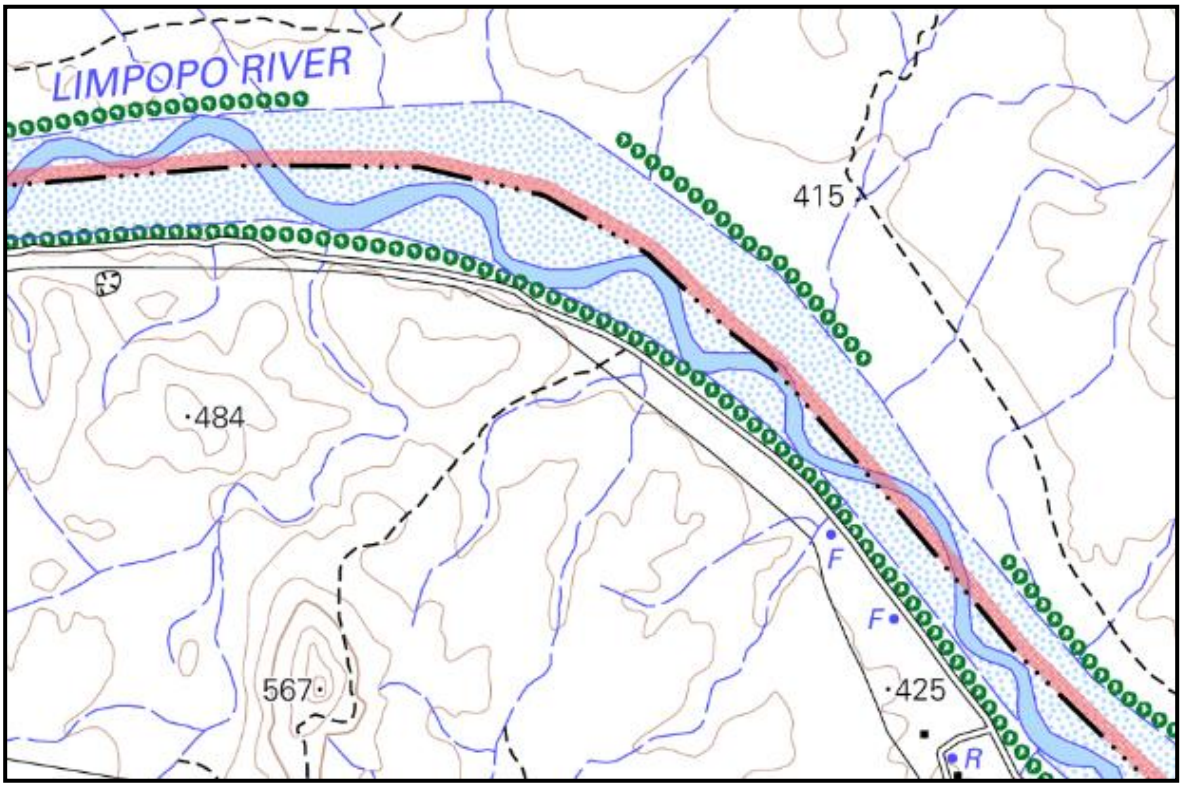
1.1.3. This area has many non parrenial stream. What does this imply about the climate of the area? (2 x 2) (4)

1.2.1. Identify the landform in which this river in map clip 1 forms. (1 x 2) (2)

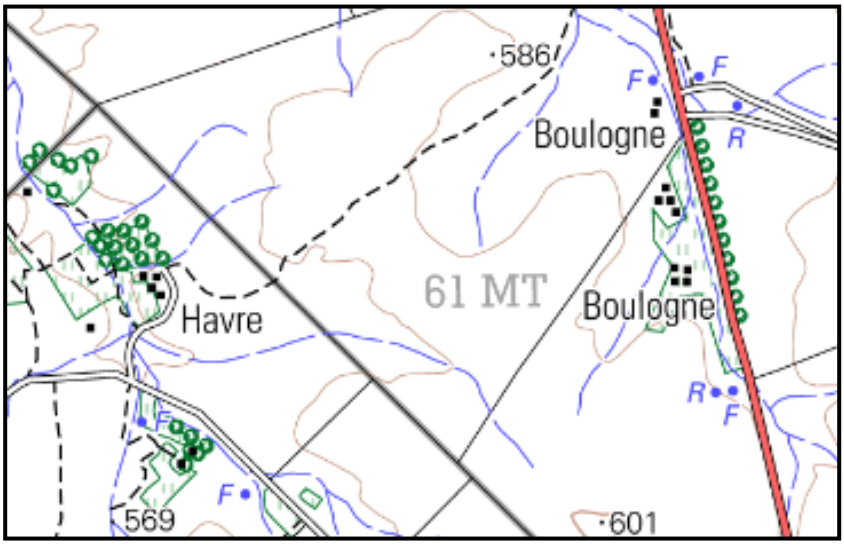
1.2.2. Identify the winds that will occur in this landfrom during the day and night respectively. (1 x 2) (2)

1.2.3. Describe how these winds develop during the night and day respectively. (6 x 2) (12)

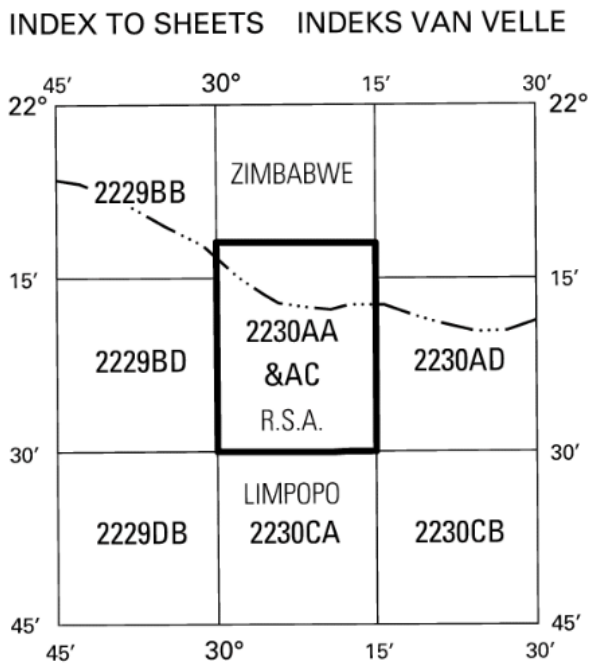
Map Clip 2.1



Map clip 2.2

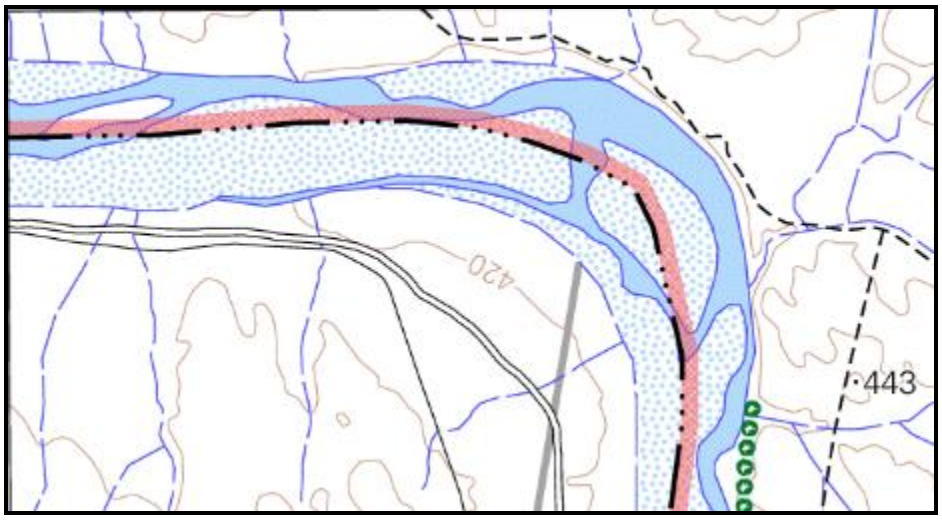


1.3. Refer to map clips 2.1 and 2.2. Give evidence from the topographical map clip above that there are groundwater sources close to the earth's surface in the mapped area. (2 x 2) (4)

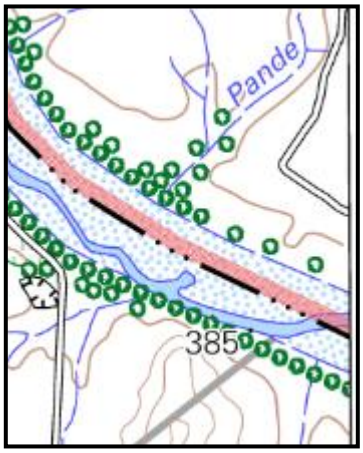


1.4. Which country lies directly to the north of the Limpopo River? (1 x 2) (2)

Norht West Side of map (Left Side) Map Clip 3



South East (Right side) Clip 4



1.5.1 What is the general direction of flow of the Limpopo River in the mapped area? (1 x 2) (2)

1.5.2 Give evidence from the map to support your answer to 1.5.1. (2 x 2) (4)

1.6.1. Identify the stream channel pattern of the Limpopo river in map clip 1 and 3 respectively. (2 x 2) (4)

1.6.2. In what stages of a river does these stream channel patterns develop? (2 x 2) (4)

1.6.3. Explain how the islands in map clip 3 form and why. (3 x 2) (6)

[52]

SECTION B: ADDITIONAL CONTENT NOTES

Refer to all the climatology and geomorphology notes that you have received so far. This has to do with application of existing knowledge on a topographic map.

SECTION C: HOMEWORK: TOPIC 2

QUESTION 1.

Refer to map clip 5 below when you answer the following questions:

1.1.1. Identify the drainage pattern in map clip 5. (1 x 2) (2)
1.1.2. On what type of rock strata does this stream pattern develop. (1 x 2) (2)
1.1.3. Describe what this stream pattern looks like. (2 x 2) (4)
1.1.4. How would this stream pattern change if it occurred on a steeper slope? (1 x 2) (2)

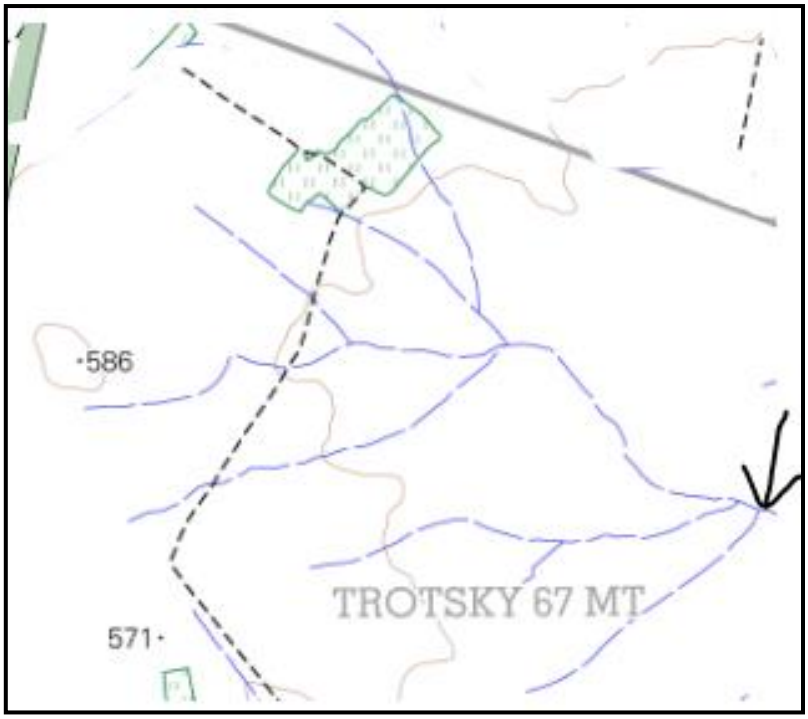
1.2.1. Order the stream and give the order at the arrow. (1 x 2) (2)
1.2.2. Identify the landform in which the river flow. (1 x 2) (2)

1.3.1 Is this a wet or dry area? (1 x 2) (2)
1.3.2. Motivate your answer in 1.3.1. (1 x 2) (2)

1.4.1. Identify the type of river that is illustrated in map clip 5. (1 x 2) (2)
1.4.2. Describe this type of river. Refer to when it flows and where it gets its water from. (3 x 2) (6)

[26]

Map Clip 5



SECTION D: SOLUTIONS TO SECTION A: TOPIC 2

QUESTION1

1.1.1 Trellis ✓✓ (1 x 2) (2)

1.1.2 Main stream flows on valley floor ✓✓
Short tributaries flow down the valley flanks ✓✓
Tributaries join main stream at 90°angles ✓✓
River drains a narrow valley ✓✓ (3 x 2) (6)

1.1.3. The area is quite dry ✓✓
It receives seasonal rainfall ✓✓ (2 x 2) (2)

1.2.1. Valley (1 x 2) (2)

1.2.2. Day – anabatic ✓✓
Night – Katabatic ✓✓ [Must refer to day and night correctly] (2 x 2) (4)

1.2.3. Day – Hill tops heat up first in the morning ✓✓
Warm air rise ✓✓
Low pressure forms on hills ✓✓
Cold air on valley floor forms High pressure ✓✓
Air blows upslope from HP to LP ✓✓
Night - Air near to surface cools down quicker than air further up ✓✓
Cold air is heavy and dense ✓✓
Sinks to valley floor forming katabatic winds. ✓✓ (6 x 2) (12)

1.3. Permanent River / Perennial River
Many water points / fountains (2 x 2) (2)

1.4. Zimbabwe (1 x 2) (2)

1.5.1. South East (1 x 2) (2)

1.5.2. River flow down River is just under 420m high in the North West corner ✓✓
River course subsided to 385m in the South East of the map. ✓✓
Tributaries join at acute angle generally West – river flow East. ✓✓ (2 x 2) (4)

1.6.1 1 – Meanderin ✓✓
3 – Braided ✓✓ (2 x 2) (4)

1.6.2. Meandering – Mature Stage/ middle course ✓✓
Braided – Old age stage ✓✓ (2 x 2) (4)

1.6.3. The river carries a lot of stream load in the mature and old age stages ✓✓
The rive slows down due to a more gradual gradient ✓✓
The river loses energy ✓✓
The river deposits the material it is carrying in the form of sandbanks that block the flow of the river. ✓✓
The river dams up behind the sandbank but the finds new courses around the sandbanks, and islands become visible in the stream. ✓✓ (3 x 2) (6)

[52]