



**GAUTENG PROVINCE**  
EDUCATION  
REPUBLIC OF SOUTH AFRICA

# **SECONDARY SCHOOL IMPROVEMENT PROGRAMME (SSIP) 2019 GEOGRAPHY**



**REVISED  
LEARNER NOTES  
SESSION 1: CLIMATOLOGY  
GRADE 12**

## GEOGRAPHY - FIRST PAPER

	How to achieve 30%	Add this to achieve 60%	Add this to achieve 70%+
<b>C L I M A T E</b>	<p><b>MIDLATITUDE CYCLONES</b></p> <ul style="list-style-type: none"> <li>• General characteristics</li> <li>• Cold front weather changes</li> <li>• Identify stages and reasons</li> </ul> <p><b>TROPICAL CYCLONES</b></p> <ul style="list-style-type: none"> <li>• General characteristics</li> <li>• Identify stages and reasons</li> </ul> <p><b>SUBTROPICAL ANTICYCLONES</b></p> <ul style="list-style-type: none"> <li>• 3 high pressure cells (location)</li> <li>• Formation: line thunderstorms</li> <li>• South African berg winds</li> </ul> <p><b>VALLEY CLIMATES</b></p> <ul style="list-style-type: none"> <li>• Aspect (which slope is warmer)</li> <li>• Anabatic/katabatic winds</li> <li>• Inversions</li> </ul> <p><b>URBAN CLIMATES</b></p> <ul style="list-style-type: none"> <li>• Why are cities warmer?</li> <li>• Definitions: heat island and pollution domes</li> </ul>	<p><b>ADD THE FOLLOWING</b></p> <p><b>MIDLATITUDE CYCLONES</b></p> <ul style="list-style-type: none"> <li>• Areas where formed</li> <li>• Weather associated with cold and warm fronts</li> </ul> <p><b>TROPICAL CYCLONES</b></p> <ul style="list-style-type: none"> <li>• Areas where formed</li> <li>• Conditions for formation</li> </ul> <p><b>SUB-TROPICAL ANTI-CYCLONES</b></p> <ul style="list-style-type: none"> <li>• Influence-high pressure cells</li> </ul> <p><b>VALLEY CLIMATES</b></p> <ul style="list-style-type: none"> <li>• Frost pockets radiation fog</li> <li>• Influence on farming and settlements</li> </ul> <p><b>URBAN CLIMATES</b></p> <ul style="list-style-type: none"> <li>• Strategies to reduce heat islands</li> </ul>	<p><b>ADD THE FOLLOWING</b></p> <p><b>MIDLATITUDE CYCLONES</b></p> <ul style="list-style-type: none"> <li>• Conditions for formation</li> <li>• Weather associated with cold, warm and occluded fronts</li> <li>• Cross sections: cold, warm and occluded fronts</li> </ul> <p><b>TROPICAL CYCLONES</b></p> <ul style="list-style-type: none"> <li>• Associated weather patterns</li> </ul> <p><b>SUB-TROPICAL ANTI-CYCLONES</b></p> <ul style="list-style-type: none"> <li>• Coastal low pressures</li> </ul>
<b>G E O M O R P H</b>	<p><b>DRAINAGE SYSTEMS</b></p> <ul style="list-style-type: none"> <li>• ALL concepts</li> <li>• Drainage patterns (all)</li> <li>• Laminar and turbulent flow</li> </ul> <p><b>FLUVIAL PROCESSES</b></p> <ul style="list-style-type: none"> <li>• Longitudinal profiles (3 stages: upper, middle and lower course)</li> <li>• Cross profiles (in 3 stages)</li> <li>• Fluvial landforms</li> <li>• River capture (how; land forms)</li> <li>• Rejuvenation (how; features)</li> </ul>	<p><b>ADD THE FOLLOWING</b></p> <p><b>DRAINAGE SYSTEMS</b></p> <ul style="list-style-type: none"> <li>• Types of rivers</li> <li>• Drainage density (high/low)</li> <li>• Laminar and turbulent flow</li> </ul> <p><b>FLUVIAL PROCESSES</b></p> <ul style="list-style-type: none"> <li>• River grading</li> </ul> <p><b>CATCHMENT/RIVER MANAGE</b></p> <ul style="list-style-type: none"> <li>• Importance</li> </ul>	<p><b>ADD THE FOLLOWING</b></p> <p><b>FLUVIAL PROCESSES</b></p> <ul style="list-style-type: none"> <li>• River grading</li> <li>• Superimposed and antecedent</li> </ul> <p><b>CATCHMENT/RIVER MANAGE</b></p> <ul style="list-style-type: none"> <li>• Importance</li> <li>• Impact of people</li> </ul>
<b>S E T T L E M E N T</b>	<p><b>RURAL SETTLEMENTS</b></p> <ul style="list-style-type: none"> <li>• Pattern: nucleated/dispersed</li> <li>• Shape of rural settlements</li> </ul> <p><b>RURAL SETTLEMENT ISSUES</b></p> <ul style="list-style-type: none"> <li>• Causes and consequences of rural depopulation</li> </ul> <p><b>URBAN SETTLEMENTS</b></p> <ul style="list-style-type: none"> <li>• Site and situation</li> <li>• Classification: central place, trade and transport, specialized</li> </ul> <p><b>URBAN STRUCTURE</b></p> <ul style="list-style-type: none"> <li>• Land use zones: CBD, industrial, residential, zone of decay, commercial, rural-urban, fringe</li> <li>• Street patterns</li> <li>• Urban profiles</li> </ul> <p><b>URBAN SETTLEMENT ISSUES</b></p> <ul style="list-style-type: none"> <li>• Traffic</li> <li>• Informal settlements and issues</li> </ul>	<p><b>ADD THE FOLLOWING</b></p> <p><b>RURAL SETTLEMENTS</b></p> <ul style="list-style-type: none"> <li>• Site and situation</li> <li>• Rural and urban settlements</li> </ul> <p><b>RURAL SETTLEMENT ISSUES</b></p> <ul style="list-style-type: none"> <li>• Social justice issues</li> </ul> <p><b>URBAN HIERARCHIES</b></p> <ul style="list-style-type: none"> <li>• Concepts</li> <li>• Lower and higher order functions</li> </ul> <p><b>URBAN STRUCTURE</b></p> <ul style="list-style-type: none"> <li>• Models of urban structure</li> </ul> <p><b>URBAN SETTLEMENT ISSUES</b></p> <ul style="list-style-type: none"> <li>• Traffic and other issues</li> <li>• Informal settlements and issues</li> </ul>	<p><b>ADD THE FOLLOWING</b></p> <p><b>RURAL SETTLEMENTS</b></p> <ul style="list-style-type: none"> <li>• Classification: function</li> </ul> <p><b>RURAL SETTLEMENT ISSUES</b></p> <ul style="list-style-type: none"> <li>• Social justice issues</li> </ul> <p><b>URBAN SETTLEMENTS</b></p> <ul style="list-style-type: none"> <li>• Origin of urban settlements</li> </ul> <p><b>URBAN HIERARCHIES</b></p> <ul style="list-style-type: none"> <li>• Lower and higher order centres</li> </ul> <p><b>URBAN STRUCTURE</b></p> <ul style="list-style-type: none"> <li>• Changing urban patterns</li> </ul> <p><b>URBAN SETTLEMENT ISSUES</b></p> <ul style="list-style-type: none"> <li>• All issues</li> </ul>

## FORMAT OF THE EXAMINATION PAPER

### 1 PAPER 1 (THEORY)

- 1.1 This is a three (3) hour paper and will be written first on the day of the Geography examination.
- 1.2 The paper is divided into two sections, namely SECTION A and SECTION B.  
SECTION A: Climate and Weather and Geomorphology  
SECTION B: Settlement Geography and Economic Geography of South Africa
- 1.3 Each of the two sections consists of two (2) questions of 75 marks each.
- 1.4 Any THREE of the four questions must be answered.
- 1.5 Each of the four questions will start with short/objective type questions of  
 $(15 \times 1) = (15)$ .
- 1.6 Each of the four questions will include two paragraph questions for (8) marks, that is two questions of  $(4 \times 2) = (8)$ . These questions may NOT be answered in point form and will require analytical thinking and insight.
- 1.7 A variety of source materials will be used, e.g. satellite images, synoptic weather charts, graphs, tables, sketch maps, cartoons, photographs and newspaper articles.
- 1.8 The following instructions and information will appear on the second page of the question paper. Learners should be advised of these instructions from the beginning of the year, as many learners do not adhere to these instructions.
- Answer ANY THREE questions of 75 marks each.
  - ALL diagrams are included in the annexure.
  - Number ALL your answers in the CENTRE of the line.
  - Where possible, illustrate your answers with labelled diagrams
  - Leave a LINE between subsections answered.
  - Start EACH question at the top of a NEW page.
  - Number your answers correctly according to the numbering system used in this question paper.
  - Do NOT write in the margins of your ANSWER BOOK.
  - ENCIRCLE the numbers of the questions that you answered on the front page of your ANSWER BOOK.
  - Write neatly and legibly.

## ACTION VERBS IN ASSESSMENTS

VERB	MEANING	SUGGESTED RESPONSE
Account	to answer for - explain the cause of - so as to explain why	Full sentences
Analyse	to separate, examine and interpret critically Full sentences	Full sentences
Annotate	to add explanatory notes to a sketch, map or drawing	Add labels to drawings
Appraise	to form an opinion how successful/effective something is	Full sentences
Argue	to put forward reasons in support of or against a proposition	Full sentences
Assess	to carefully consider before making a judgment	Full sentences
Categorise	to place things into groups based on their characteristics	One-word answers/phrases
Classify	to divide into groups or types so that things with similar characteristics are in the same group - to arrange according to type or sort	One-word answers /phrases
Comment	to write generally about	Full sentences
Compare	to point out or show both similarities and differences	Full sentences
Construct	to draw a shape	A diagram is required
Contrast	to stress the differences, dissimilarities, or unlikeness of things, qualities, events or problems	Full sentences
Create	to develop a new or original idea	Full sentences
Criticise	to make comments showing that something is bad or wrong	Full sentences
Decide	to consider something carefully and decide what should be done	Full sentences
Defend	to say things to protect something	Full sentences
Define	to give the concise and clear meaning	Full sentences
Devise	to invent a method to do something	Full sentences
Demonstrate	to show or make clear - to illustrate and explain - to prove by reasoning and evidence - examples can be given	Full sentences
Describe	to list the main characteristics of something - give an account of	Full sentences
Develop	to successfully develop and create a new method/idea	Full sentences
Differentiate	to show the difference between things	Full sentences
Discriminate	to recognise the difference between things	Full sentences
Discuss	to examine by means of argument, presenting both sides and reaching a conclusion	Full sentences
Distinguish	to recognise the difference between things	Full sentences
Draw	to show by means of a sketch	A diagram is required

VERB	MEANING	SUGGESTED RESPONSE
Evaluate	to make an appraisal or express an opinion concerning the value - to define, analyse and discuss	Full sentences
Examine	to look at something carefully - to analyse and discuss	Full sentences
Explain	to make clear, interpret and spell out the material you present	Full sentences
Find	to make a formal decision about something	Full sentences
Formulate	to express an idea/opinion in a carefully organised way	Full sentences
Give	to state facts without discussions	One-word answers
Identify	to give the essential characteristics of - to name	One-word answers
Illustrate	to show what something is like - to show that something is true	Full sentences
Interpret	to give an explanation of - to give the meaning of	Full sentences
Investigate	To try to find the facts about something	Full sentences
Justify	List to write an itemized series of concise statements to prove or give reasons for decisions or conclusions, using logical argument	Full sentences One-word answers
Locate	to find the exact place where something is	One-word answers
Mention	providing relevant facts	Full sentences
Name	to state something - give, identify or mention	One-word answers
Outline	give a summary, using main points and leaving out minor details	Full sentences
Plan	to think carefully about a series of actions that you need to take in order to achieve something	Full sentences
Predict	to say what you think will happen - to foretell - to say in advance	Full sentences
Prioritise	to place in order of importance	One-word answers
Propose	to suggest a plan - to make a formal suggestion	Full sentences
Provide	to state facts without discussions	Full sentences/ one-word answers
Question	to have or express doubts about something	Full sentences
Rate	to consider that something has a particular quality or achieved a particular quality/level	Full sentences/ one-word answers
Recall	to remember something	Full sentences/ one-word answers
Recognize	to accept that something is true or important - to give approval to something	Full sentences/ one-word answers
Recommend	to advise that something should be done	Full sentences
Report	to produce an official statement or	Full sentences

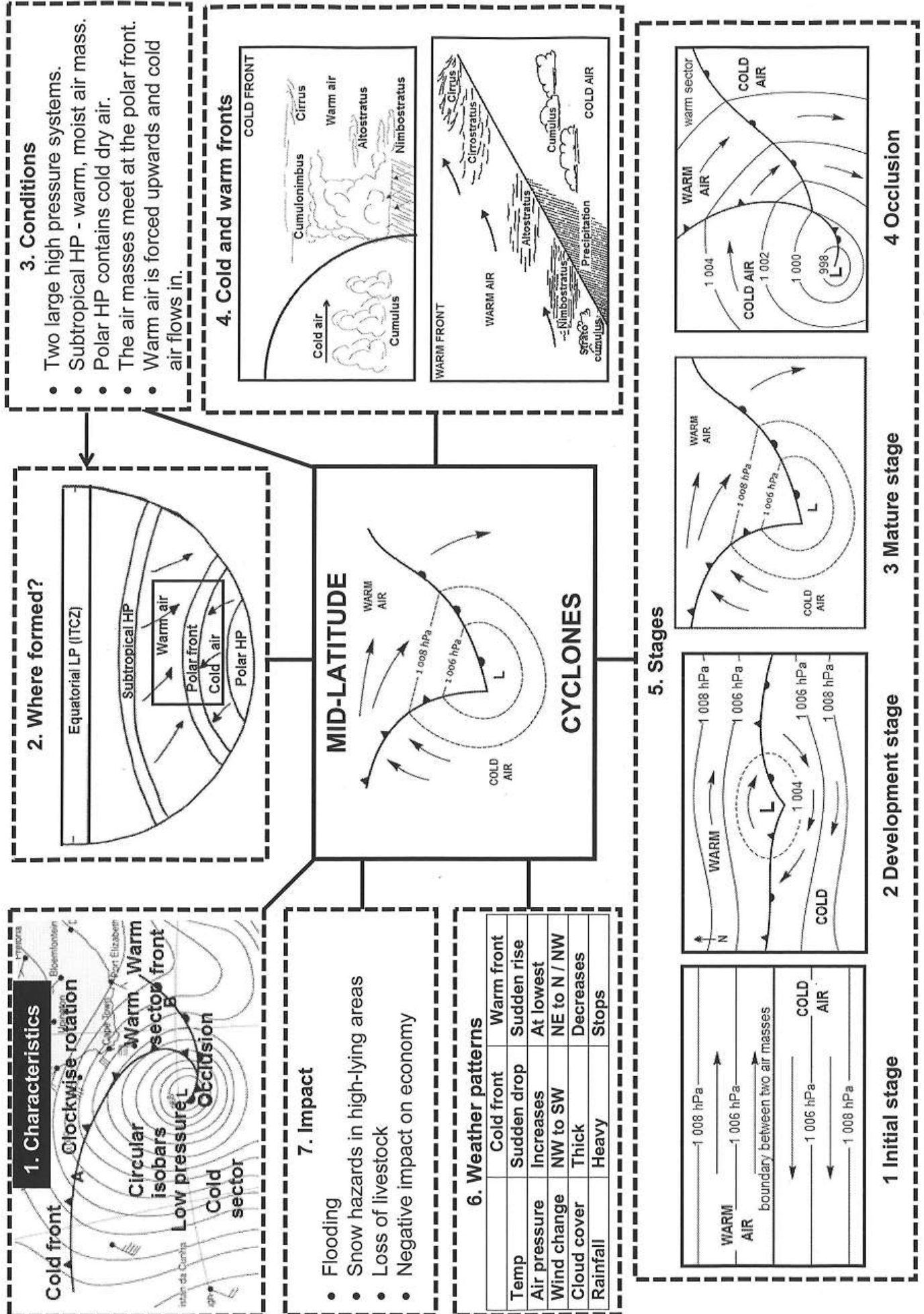
VERB	MEANING	SUGGESTED RESPONSE
	written document	
Select	to choose something from a greater whole	One-word answers
Sketch	to illustrate with a simple drawing	A diagram is required
Solve	to find a solution to something that is causing difficulties	Full sentences
State	to present information plainly without discussion	One-word answers
Suggest	to propose an explanation or solution	Full sentences
Show	to make clear - to point out - to explain	Full sentences
Support	to show that an idea/statement is true	Full sentences
Tabulate	to group like terms or activities under specific headings	One-word answers/phrases
Tell	to recognize something as a result of knowledge	One-word answers
Test	To examine something to find out if it is satisfactory or has a specific quality	Full sentences
Use	To do something using a specific skill or method	Full sentences
Value	to consider the importance/worth of something	Full sentences
Verify	to check/prove that something is correct	Full sentences
Write	to create a formal document	Full sentences



## TABLE OF CONTENTS

SESSION	TOPIC	PAGE
1	MID-LATITUDE CYCLONE	
2	TROPICAL CYCLONES	
3	ANTICYCLONIC MOVEMENT OVER SA	
4	MICROCLIMATE – VALLEY / URBAN	

**SESSION 1: CLIMATE AND WEATHER**  
**TOPIC 1.1: MID-LATITUDE CYCLONES**



## SECTION A: CONTENT NOTES ON MID-LATITUDE CYCLONES

### TERMINOLOGY / DEFINITIONS (counts up to 25% of Paper 1)

**Polar Easterly winds:** Cold dry winds blowing between the polar high pressure cell and the sub-polar low pressure belt.

**Westerly Winds:** Moist warmer winds blowing from the sub-tropical high pressure belt to the sub-polar low pressure belt.

**Ferrell cell:** global circulation cell between 30° - 60° S/N

**Sub-polar Low pressure belt:** Low pressure area at around 60°N/S and uplift causes low pressure cells.

**Polar front:** where westerly and polar easterlies meet at the polar low pressure belt

**Cold front:** boundary where cold air moves toward warm air and shifts it, but it does not mix due to different densities and temperatures.

**Warm front:** boundary where warm air moves toward cold air and glides over it as it is not dense enough to shift the cold air.

**Coriolis force:** the force caused by different rotation speeds along the latitudes of the earth, which deflects wind to the left in the Southern hemisphere and to the right in the Northern hemisphere.

**Cyclone:** intense low pressure cell where air rise and clouds form

**Mid altitude cyclones:** intense low pressure storms system that develops along the polar front and influences weather in the mid-latitudes (30° - 60°N/S)

**Backing of wind:** wind changes direction due the clockwise movement of air around a low pressure in the southern hemisphere.

**Veering of winds:**

**Cumulonimbus clouds:** vertically developed clouds causing precipitation- it form along the cold front due to steep gradient

**Stratus clouds:** horizontally developed grey clouds – forms along the warm front

**Warm sector:**

**Cold sector:**

**Occlusion front:**

**Cold front occlusion:**

**Warm front occlusion:**



## IMPORTANT CONCEPTS AND EXPLANATIONS

### 1. MID-LATITUDE CYCLONES (MLC) / TEMPERATE DEPRESSIONS

#### 1.1. General characteristics of MLC

Mid latitude cyclones consist of a low pressure cell, a well-developed cold front, a warm front and a cold and warm sector.

It occurs in the westerly wind belt which push the MLC's from west to east.

Associated with changing weather, rain and cold conditions

It occur right through the year but shifts north and south with the shifting of the direct sunlight through the seasons.

#### 1.2. Areas of formation of MLC

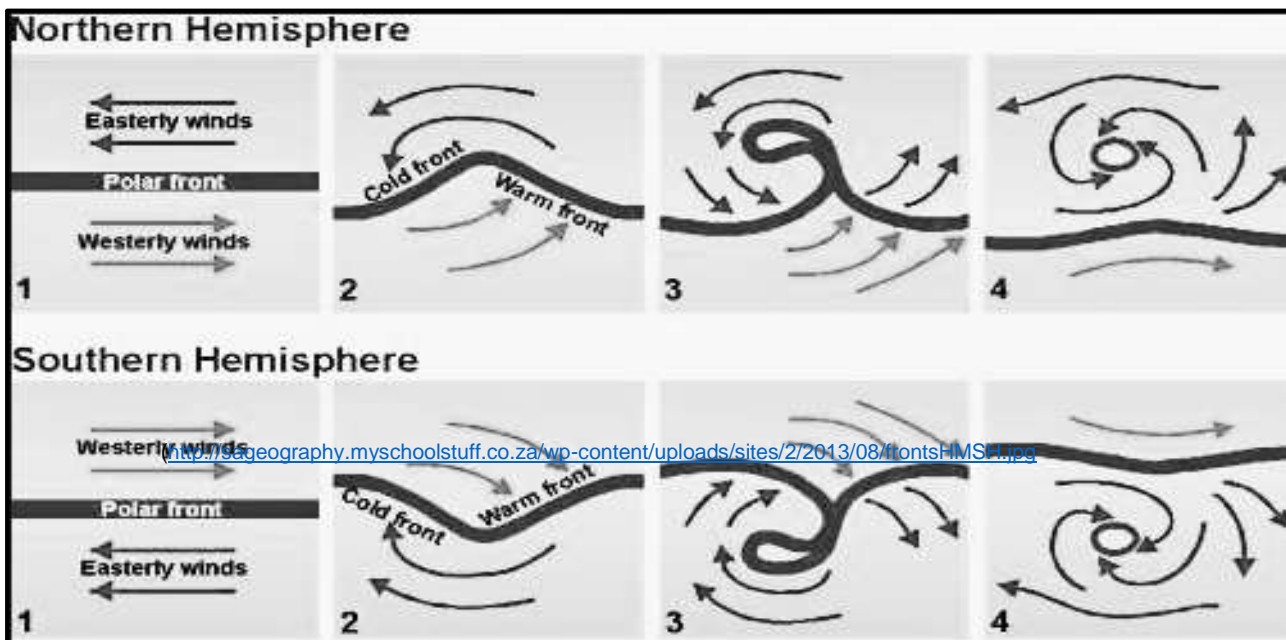
Starts at the Polar front (60°N/S) where polar easterlies meet Westerly winds  
Occur and influence weather in Ferrell cell between 30° and 60°N/S

#### 1.3. Conditions necessary for formation of MLC

Cold Polar Easterlies meet warmer Westerly wind and blow in opposite directions – this cause friction and a wave develops along the polar front.

Upper air divergence – jet streams

#### 1.4. Stages in the formation of MLC



Stage 1: Polar front stage and Wave stage	Stage 3: Warm / Mature sector stage	Stage 4: Occlusion stage	Stage 5: Dissipating Stage
Westerly and polar easterlies blow in opposite directions at the polar front. A wave forms along the polar front where	Cold air moves towards warm air and lifts it along the cold front Cold sector larger than warm sector	Cold front catches up with warm front and lifts warm air – occlusion front develops	All warm air is lifted up and the system breaks up as the air pressure increases and the clouds clear up.

the Sub-polar low pressure cells then intensifies – cyclone	Low pressure drops to <1000hPa		
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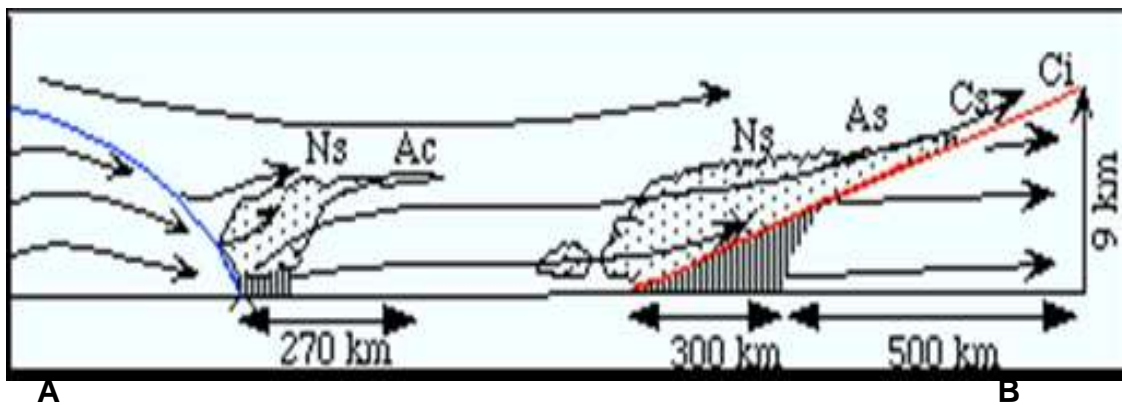
**1.5. Associated weather patterns** – see the table after the sketch expected weather as different parts of the Mid-latitude cyclone passes over a place.

1.5.1. Cold front conditions – see table below for description

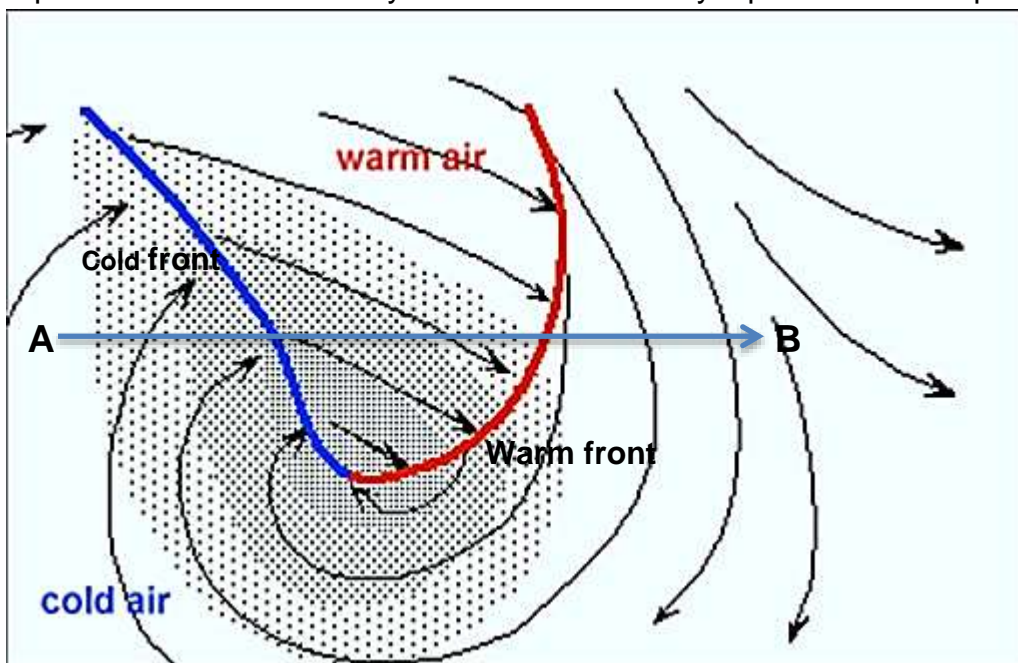
1.5.2. Warm front conditions – see table below for description

1.5.3.

Cross section through a Mid-latitude Cyclone – along line A – On next sketch



Top view of a mid-latitude cyclone as seen on a synoptic weather map



<http://sageography.myschoolstuff.co.za/wp-content/blogs.dir/2/files/mid-latitude-cyclones/1coldfronts.gif>

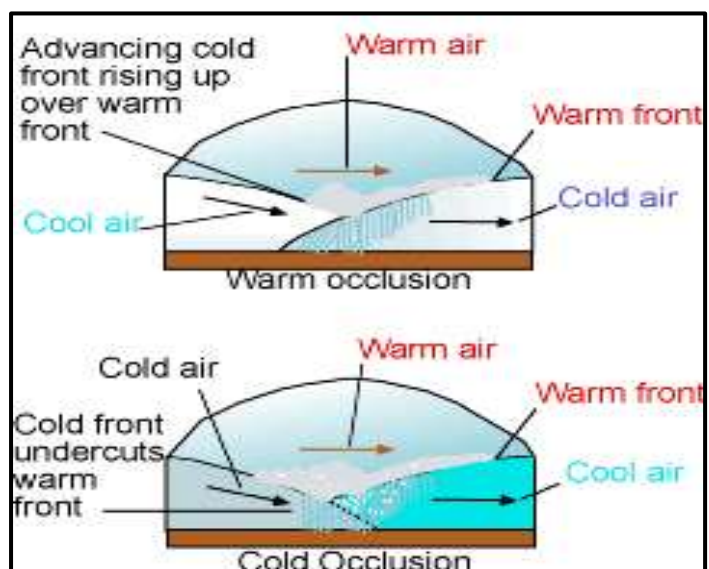
The MLC move from west to east. Places will experience conditions from B to A.

MLC	Weather experienced
-----	---------------------

Cold sector before warm front - <b>B</b>	<ul style="list-style-type: none"> <li>• Cold dry conditions</li> <li>• Air Pressure dropping</li> <li>• Winds strengthening</li> </ul>	<p>Northerly winds Cirrus clouds visible No precipitation</p>
Warm front	<ul style="list-style-type: none"> <li>• At the warm front the warm air cannot push the cold dense air away and glides over the cold air.</li> <li>• This leads to nimbostratus clouds to form and soft prolonged rain to occur.</li> <li>• At the warm front the air pressure decreases,</li> <li>• but the humidity and temperature increases.</li> <li>• North Westerly winds</li> <li>• Warm front has a gradual gradient of 1:150 and 1:300</li> </ul>	
Warm sector	<ul style="list-style-type: none"> <li>• Temperature at highest</li> <li>• Some clouds with scattered rain, but the weather clears up partially</li> <li>• Humidity increases</li> </ul>	<p>Lowest air pressure North westerly, westerly winds</p>
Cold front	<ul style="list-style-type: none"> <li>• The cold dense air moves faster and pick up the light humid less dense air in the warm sector.</li> <li>• This leads to Cumulonimbus clouds to form and heavy rain along the cold front.</li> <li>• The temperature and humidity decreases at the cold front while the air pressure increases.</li> <li>• The air at the cold front is lifted quickly and thus thunderstorms develop at the cold front.</li> </ul>	
Cold sector after cold front – <b>A on sketch</b>	<ul style="list-style-type: none"> <li>• Cold conditions</li> <li>• Weather clears up</li> <li>• Air pressure rises</li> <li>• Winds slow down</li> </ul>	<p>Dry air – low humidity Few cumulus clouds South westerly winds</p>

### 1.5.4. OCCLUDED FRONT CONDITIONS

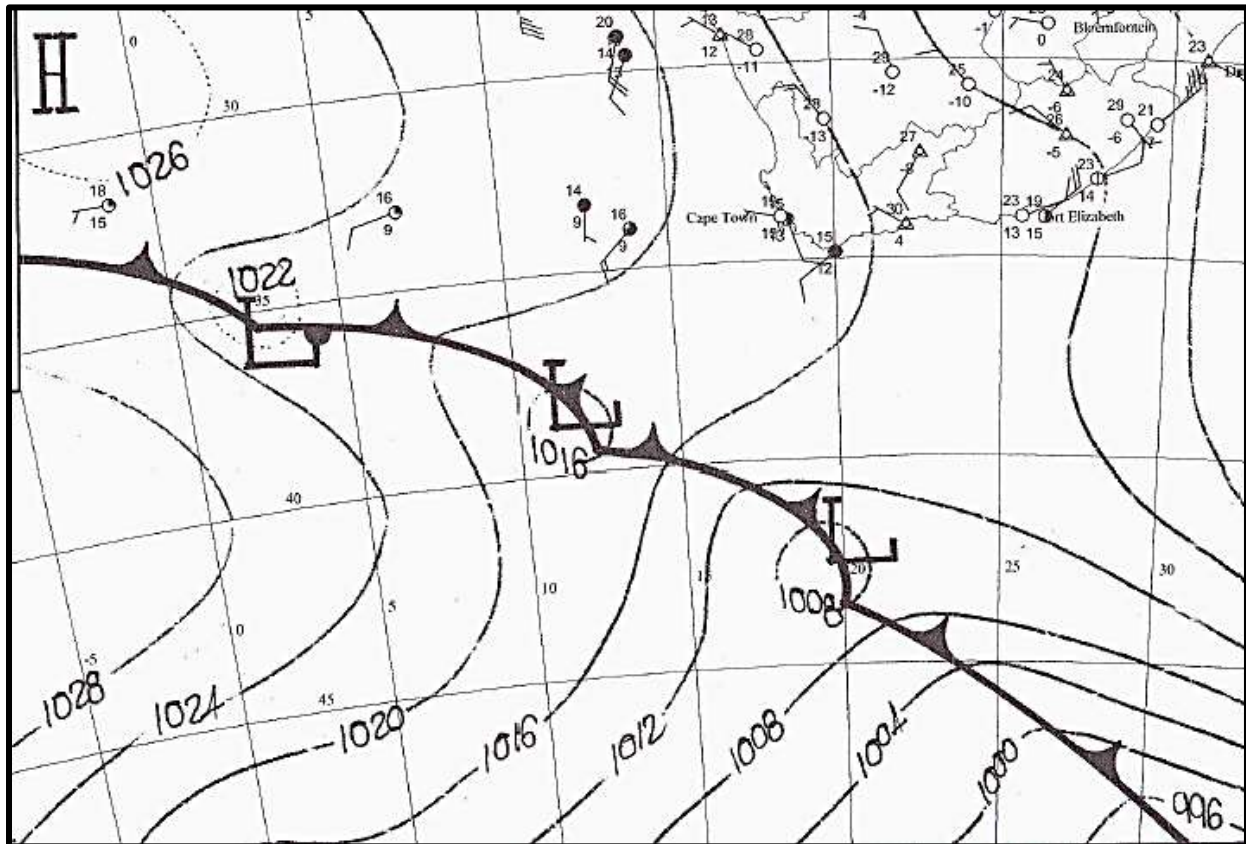
Wide spread rain  
Surface temperatures cold  
All warm air lifted  
Air pressure increases  
Weather starts to clear



<http://imnh.isu.edu/digitalatlas/clima/atmosph/climimgs.htm>

## 1.6. CYCLONE FAMILIES

Mid latitude cyclones occur in quick succession where one cold front is linked to the next warm front or they are very near to each other. The cyclone furthest east is the oldest regardless of the stage of the cyclone.



## 1.7. IMPACT ON HUMAN ACTIVITIES AND THE ENVIRONMENT

Impact on human activities	Impact on the environment
<p><b>Positive:</b> provide rain for agriculture Increase yield and income Snow can be tourist attraction</p> <p><b>Negative:</b> Cold conditions and Flooding can cause loss of life, damage to houses stock losses and damage to crops Costly repairs and aid projects</p>	<p><b>Positive:</b> Rain to sustain natural vegetation and indigenous animals</p> <p><b>Negative:</b> Flooding causes erosion of topsoil and loss of fertile soil Eroded material silt up rivers, dams and coastal areas. Cold conditions can lead to vegetation damage and loss of wild species.</p>

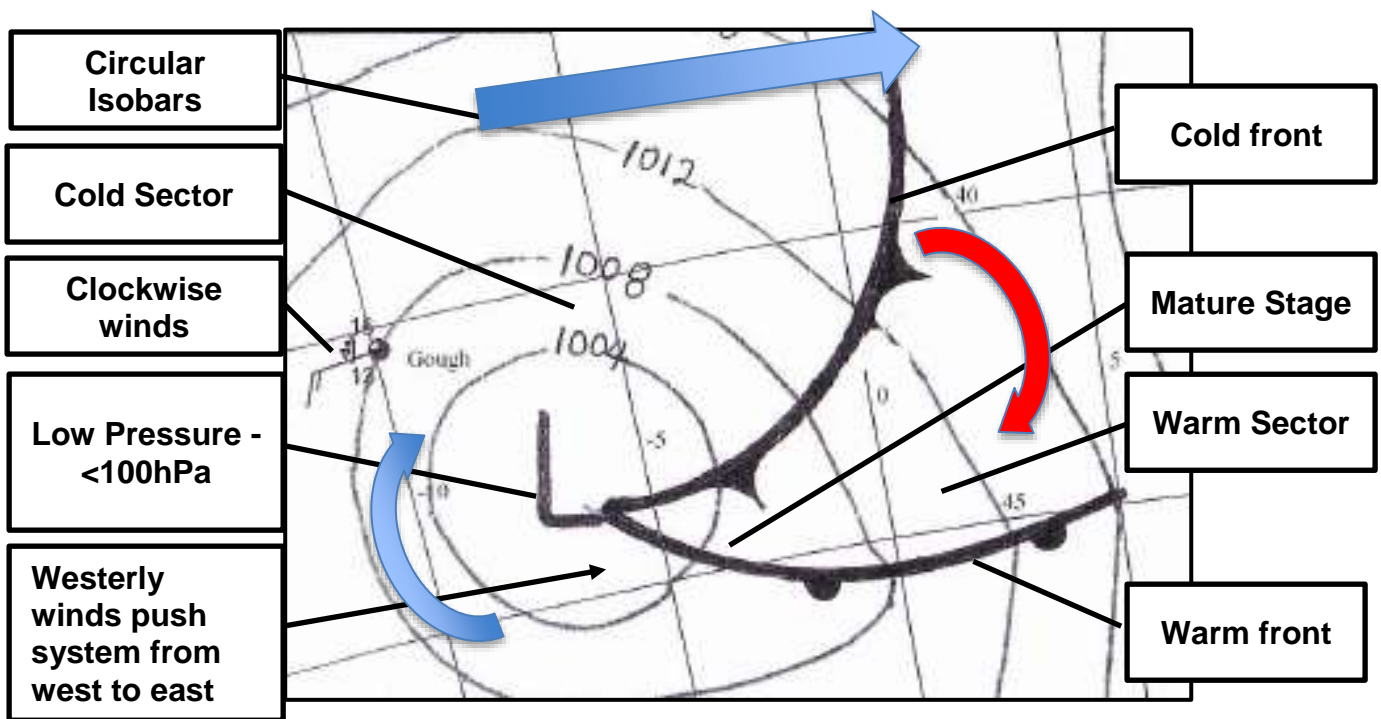
## 1.8. POSSIBLE PRE-CAUTIONARY AND MANAGEMENT STRATEGIES

Early warning systems to warn farmers to bring stock in  
Plant crops that can withstand the cold  
Do not build or farm in areas that get flooded often – build above flood lines  
Stay indoors when cold front passes and keep stock in sheds  
Disaster management plans to ensure affected areas can be assisted quickly.

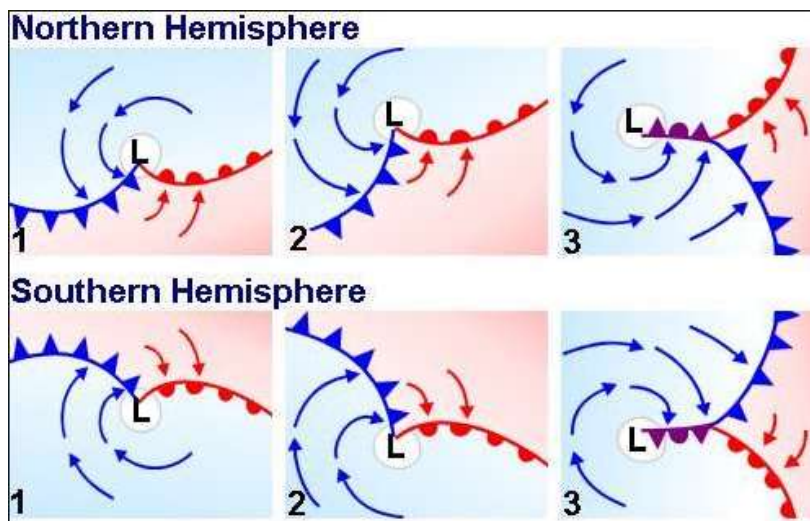
### 1.9. Identification on synoptic weather maps and satellite images

Use the sketch and labels below to assist you in identify the components of a mid-latitude cyclone.

The circulation in the cyclone is clockwise but the whole system moves from west to east steered by the westerly winds.



### 1.10. Identification of stages of development on synoptic weather maps



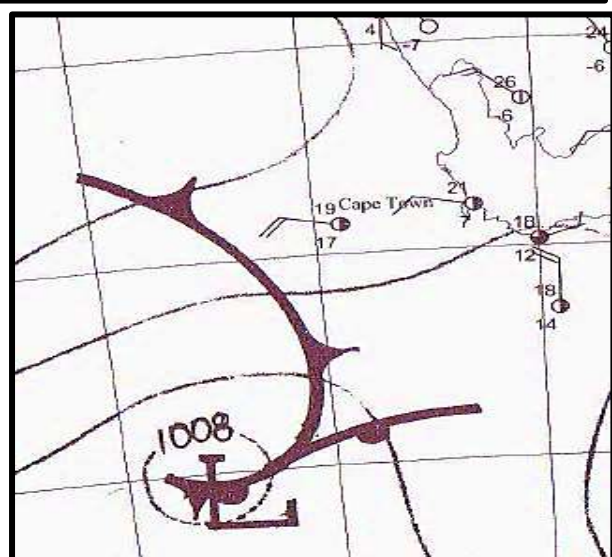
Stages 1 and 2 on these sketches indicate the mature stage and 3 illustrates the occluded stage.

### 1.11. INTERPRETATION OF WEATHER SYMBOLS, PREDICTED WEATHER AND IMPACT

Use these symbols to be able to read the station models on synoptic weather maps.

KEY		SLEUTEL
AIR TEMPERATURE	TT	LUGTEMPERATUUR
DEW POINT	T <sub>d</sub> T <sub>a</sub>	DOUPUNT
The arrow flies with the wind Each feather represents 10 knots		Die pyltjie beweeg met die wind Elke veer stel 10 knope voor
CLOUD AMOUNT		WOLKBEDEKKING

	Duststorm / Stofstorm
	Fog / Mis
	Drizzle / Motreën
	Rain / Reën
	Snow / Sneeu
	Showers / Buie
	Thunderstorm / Donderstorm



Use the clip from a synoptic map above to see the following about MLC

- Mid-latitude cyclone visible (Low pressure, cold, warm & occluded fronts)
- System moves from west to east pushed along by the westerly winds
- Occluded stage – occlusion front
- Winds in cyclone moves clockwise parallel to isobars due to Coriolis force
- The weather changes in Cape Town as the cyclone moves eastwards
  - Temperature will drop
  - Heavy rain from Cumulonimbus clouds
  - Air pressure will drop and then start rising
  - Wind direction will change from west to south west (backing)
  - Air pressure will rise as cold front passes over.

**STUDY TIPS:**

- ✓ Know the definitions
- ✓ You must be able to identify the Mid-latitude cyclone on a synoptic weather map and say why it is a MLC.
- ✓ You must be able to tell how weather will change as the MLC moves over a place
- ✓ You must know in which wind belt MLC's occur
- ✓ Must be able to describe and discuss impact on people and the environment.

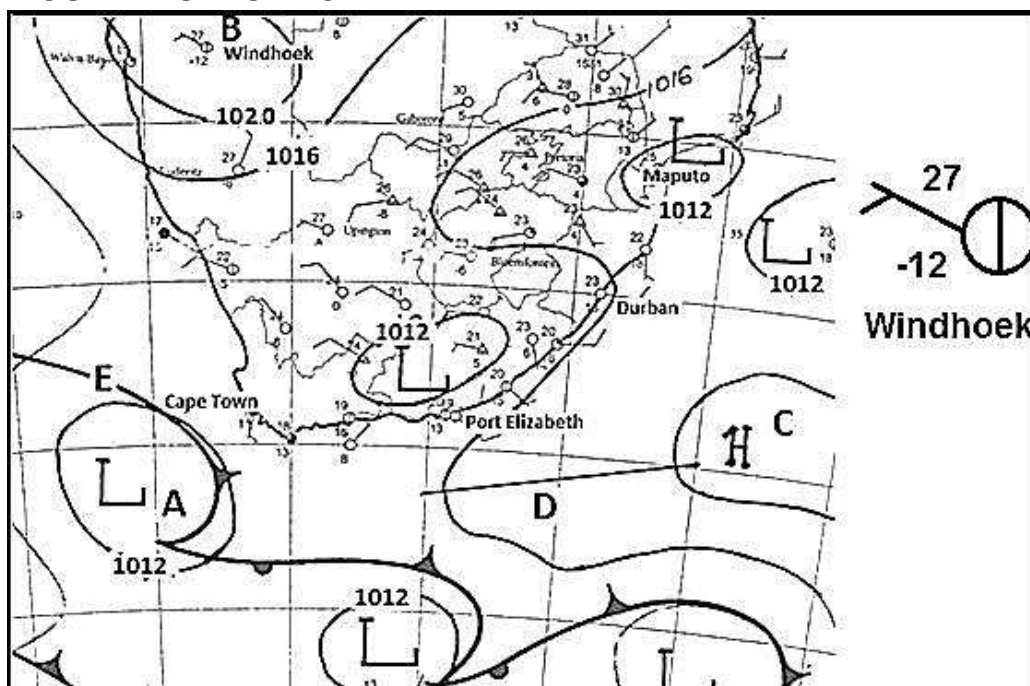
**SECTION B: TYPICAL CAPS EXAM QUESTIONS MID-LATITUDE CYCLONE**

**CLIMATOLOGY**

(November 2014)

Mid latitude cyclone

**FIGURE 1: SYNOPTIC WEATHER MAP**

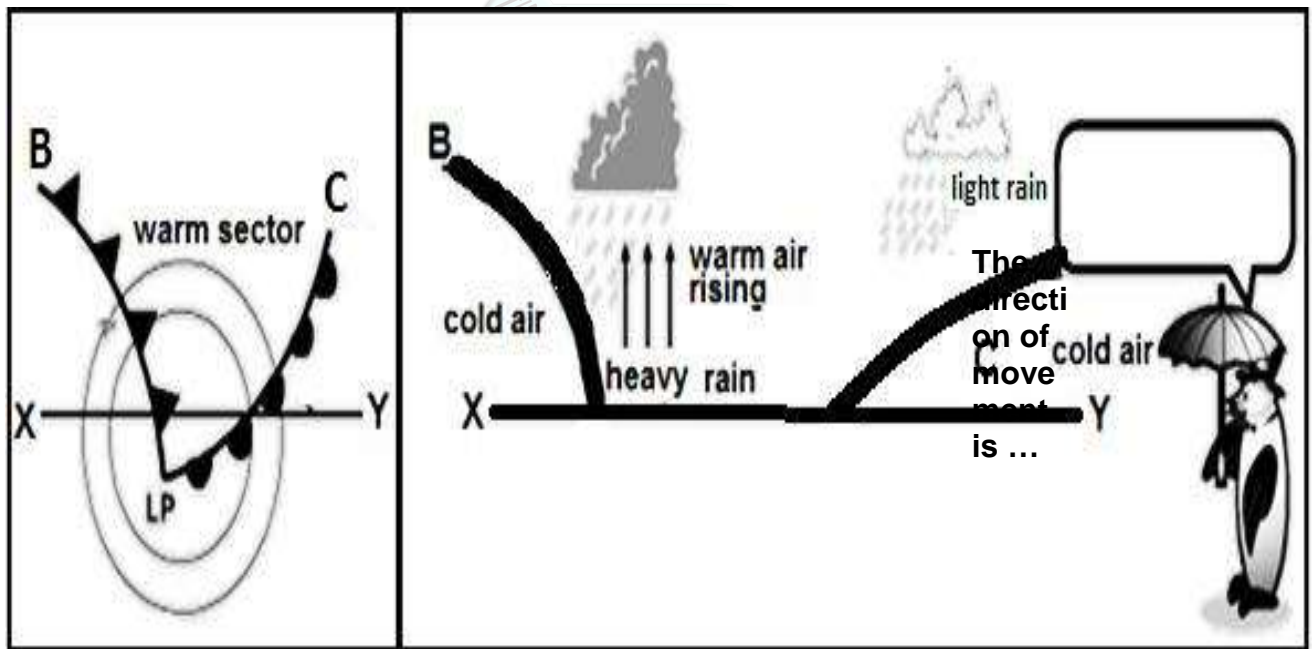


© Gauteng Department of Education

[Source: South African Weather Bureau]

- 1.1. Study the synoptic weather map in FIGURE 1. and answer the questions that follow.
- 1.1.1. Give the term used to describe the linked mid-latitude cyclones on the synoptic weather map. (1 x 1) (1)
- 1.1.2. Refer to mid-latitude cyclone **A**.
- (a) Draw a labelled cross-section of front **E**. (4 x 1) (4)
- (b) Describe ONE weather change associated with the passing of front **E**. (1 x 2) (2)
- 1.1.3. Refer to the weather station at Windhoek (**B**). In a paragraph of approximately EIGHT lines, describe and give reasons for any TWO weather conditions recorded at the weather station. (4 x 2) (8)

FIGURE 2: MID-LATITUDE CYCLONE (Feb 2015)



- 2.1. Study the plan view of and the cross-section through a mid-latitude cyclone in

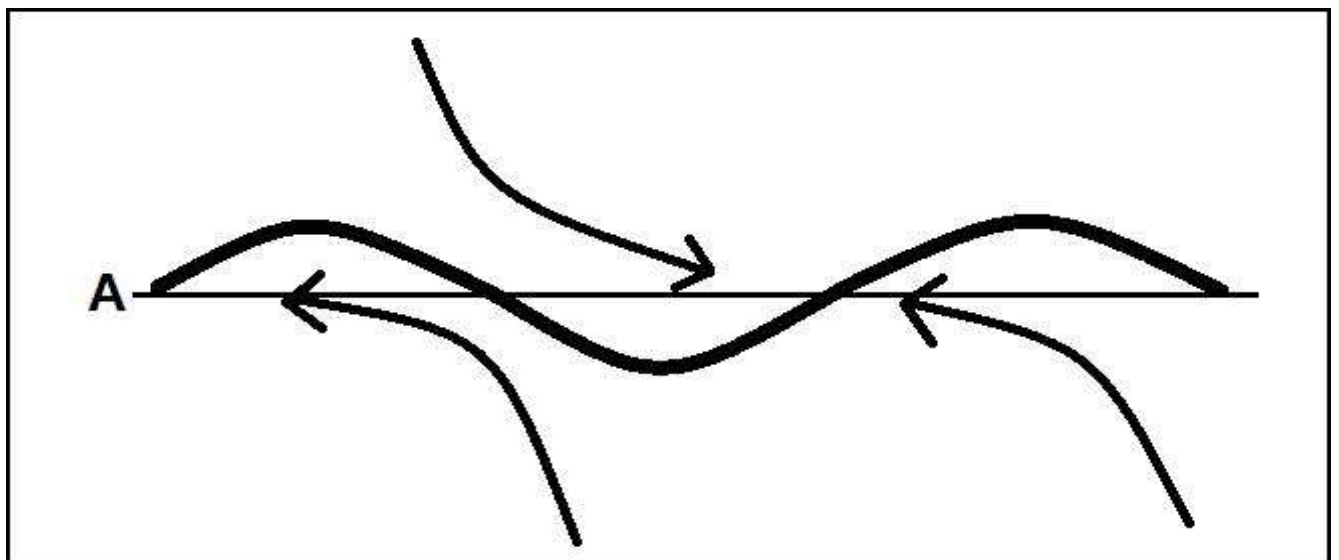


FIGURE 2.

- 2.1.1. In which general direction does this cyclone move in the Southern Hemisphere? (1 x 1) (1)
- 2.1.2. Give TWO pieces of evidence to support the statement that the cyclone is in its mature stage. (2 x 2) (4)
- 2.1.3. Why does the warm front (C) have very little influence on the weather of South Africa? (1 x 2) (2)
- 2.1.4. In a paragraph of approximately EIGHT lines, explain the process of occlusion and associated weather conditions of a mid-latitude cyclone. (4 x 2) (8)



FIGURE 3. DEVELOPMENT OF A MID-LATITUDE CYCLONE (June 2015)

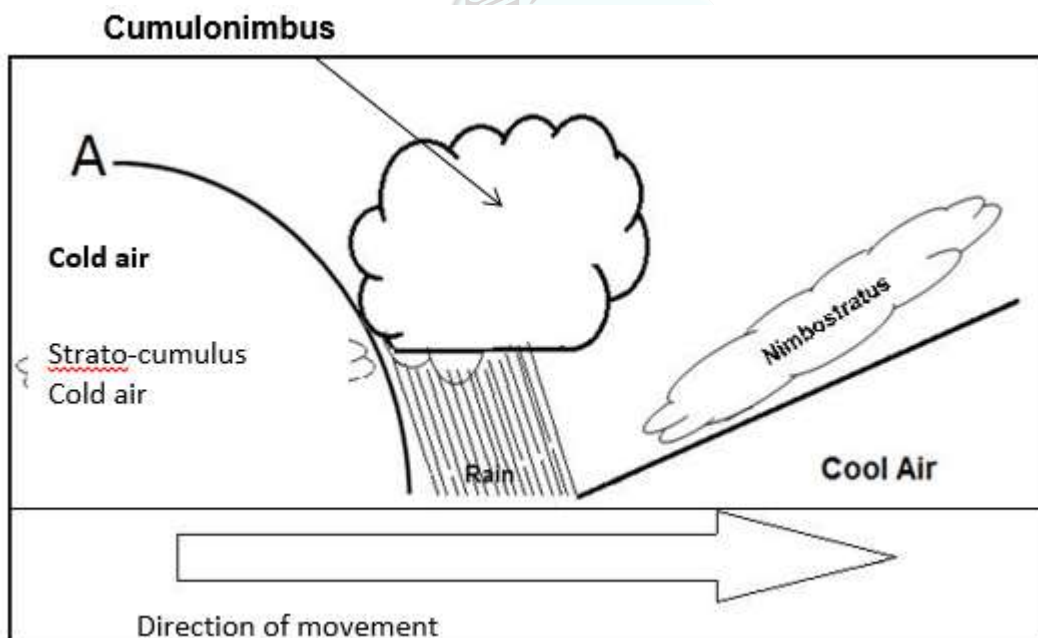


- 3.1. Refer to FIGURE 3 showing a stage in the development of a mid-

latitude cyclone. Choose the correct word(s) from those given in brackets. Write only the word(s) next to the question number (1.1.1–1.1.7) in the ANSWER BOOK.

- 3.1.1. A mid-latitude cyclone is also known as a (coastal low pressure/extratropical cyclone).
- 3.1.2. The mid-latitude cyclone in FIGURE 3. develops in the (Southern/Northern) Hemisphere.
- 3.1.3. A mid-latitude cyclone is a (high/low)-pressure system.
- 3.1.4. The stage of development shown in FIGURE 3 is the (wave/mature) stage.
- 3.1.5. A mid-latitude cyclone moves in a/an (easterly/westerly) direction.
- 3.1.6. A mid-latitude cyclone has a greater influence in South Africa in (summer/winter).
- 3.1.7. Line **A** is the (40°/60°) latitude. (7 x 1) (7)

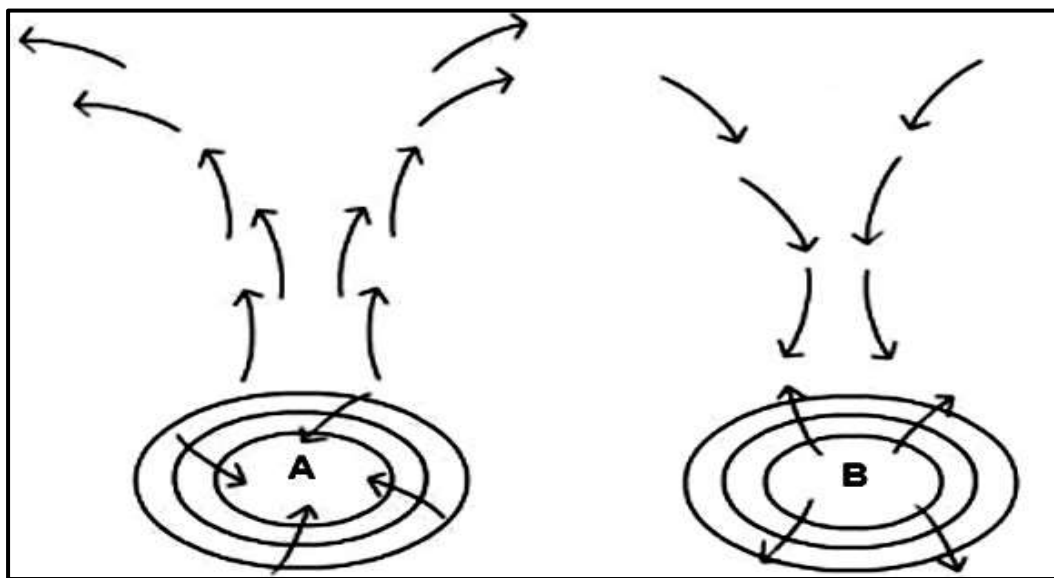
**FIGURE 4: CROSS-SECTION OF A MIDLATITUDE CYCLONE (Nov 2015)**



- 4.1 Study FIGURE 4, which shows a cross-section of a cold front, and answer the questions that follow.
- 4.1.1 Give ONE point of evidence that **A** shows a cross-section of a cold front. (1 x 1) (1)

- 4.1.2 Why do cumulonimbus clouds develop along front **A**? (1 x 2) (2)
- 4.1.3. Once the cold front passes over, air pressure will increase. Explain why this is the case. (2 x 2) (4)
- 4.1.4. With reference to the diagram in FIGURE.4, write a paragraph of approximately EIGHT lines in which you explain the development of a cold front occlusion. (4 x 2) (8)

**FIGURE 5: PRESSURE CELLS (2014 exemplar)**



5.1. Refer to FIGURE 5.1 showing two pressure cells in the Southern Hemisphere.

Indicate whether the descriptions below refer to pressure cell **A** or **B**. Write only the answer next to the question number (5.1.1–5.1.8) in the ANSWER BOOK. You may use the same answer more than once.

- 5.1.1. An example of a high-pressure cell
- 5.1.2. Air converges into the pressure cell
- 5.1.3. This pressure cell dominates the land in winter over South Africa
- 5.1.4. Air diverges from this cell
- 5.1.5. Associated with clear skies and stable weather

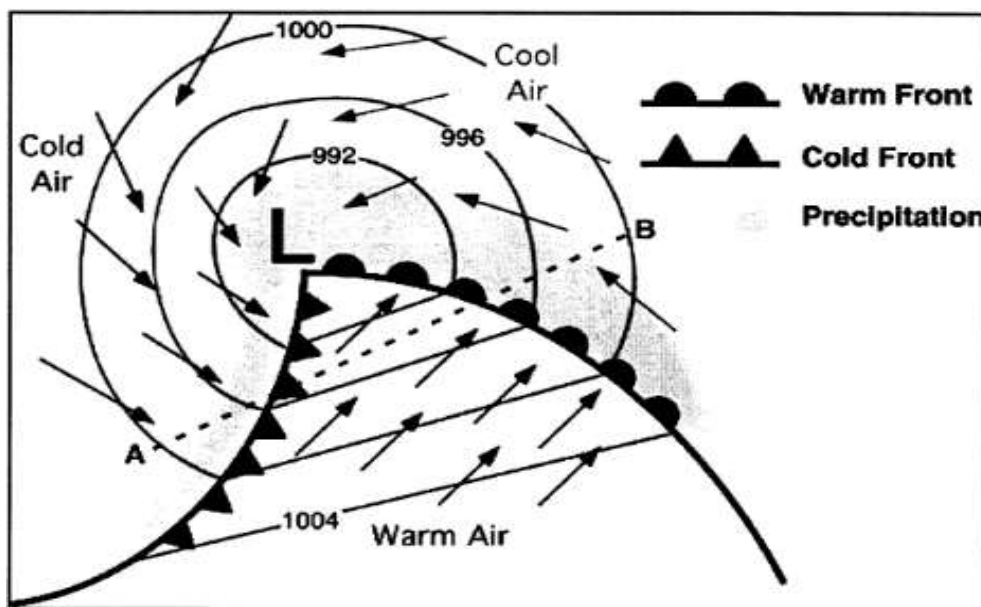
5.1.6. Also known as a cyclone

5.1.7. Associated with warm, rising air

5.1.8. Associated with the Tropical Pressure Belt (8 x 1) (8)

**SECTION C: HOMEWORK QUESTIONS ON MID-LATITUDE CYCLONES**

**QUESTION 1:** 25 minute [30]  
(Taken from NSC September Prep Exam 2013 Paper 1)



1.1. Study the figure below illustrating a weather system and answer the following questions.

1.1.1. Name the weather system illustrated. (1 x 1 = 1)

1.1.2. a. In which hemisphere is this weather system? (1 x 2 = 2)

b. Give two reasons for your answer in 1.1.2. a. (2 x 2 = 4)

1.1.3. a. In which stage of development is this cyclone? (1 x 1 = 1)

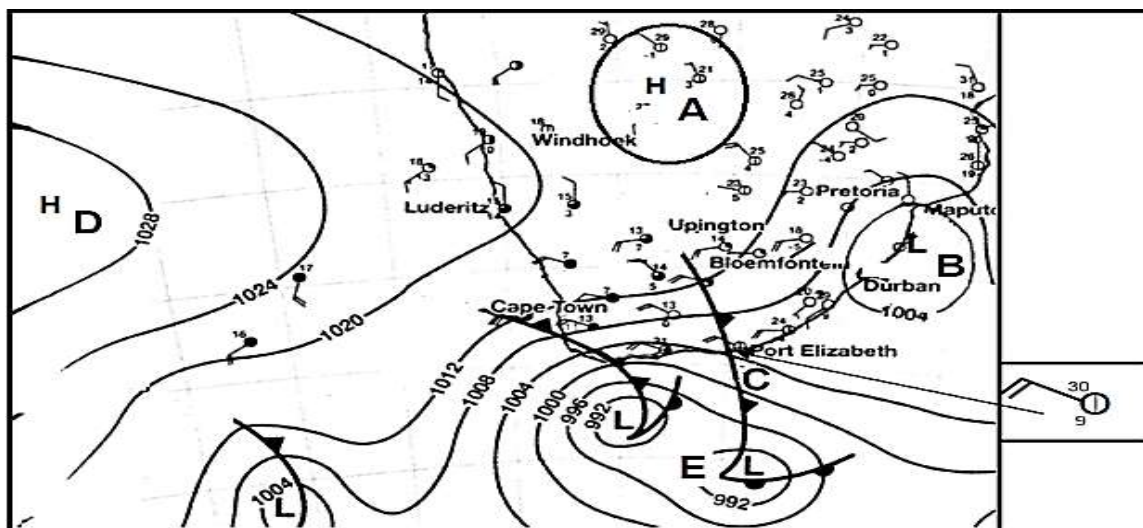
b. Motivate your answer in 1.1.3. a with evidence from the sketch. (2 x 2 = 4)

1.1.4. State three changes that could occur in the weather patterns when the cold front passes over an area. (3 x 2 = 6)

1.1.5. These weather systems have an impact on human activities and the environment in the areas where they occur. In a paragraph of no more than 12 lines discuss the positive and negative consequences such weather systems have on agriculture. (4 x 2 = 4)

1.1.6. Draw a simple well labelled sketch from A to B through the weather system. Illustrate and label the air masses, movement, clouds, components and precipitation of this weather system. (8 x 1 = 8)

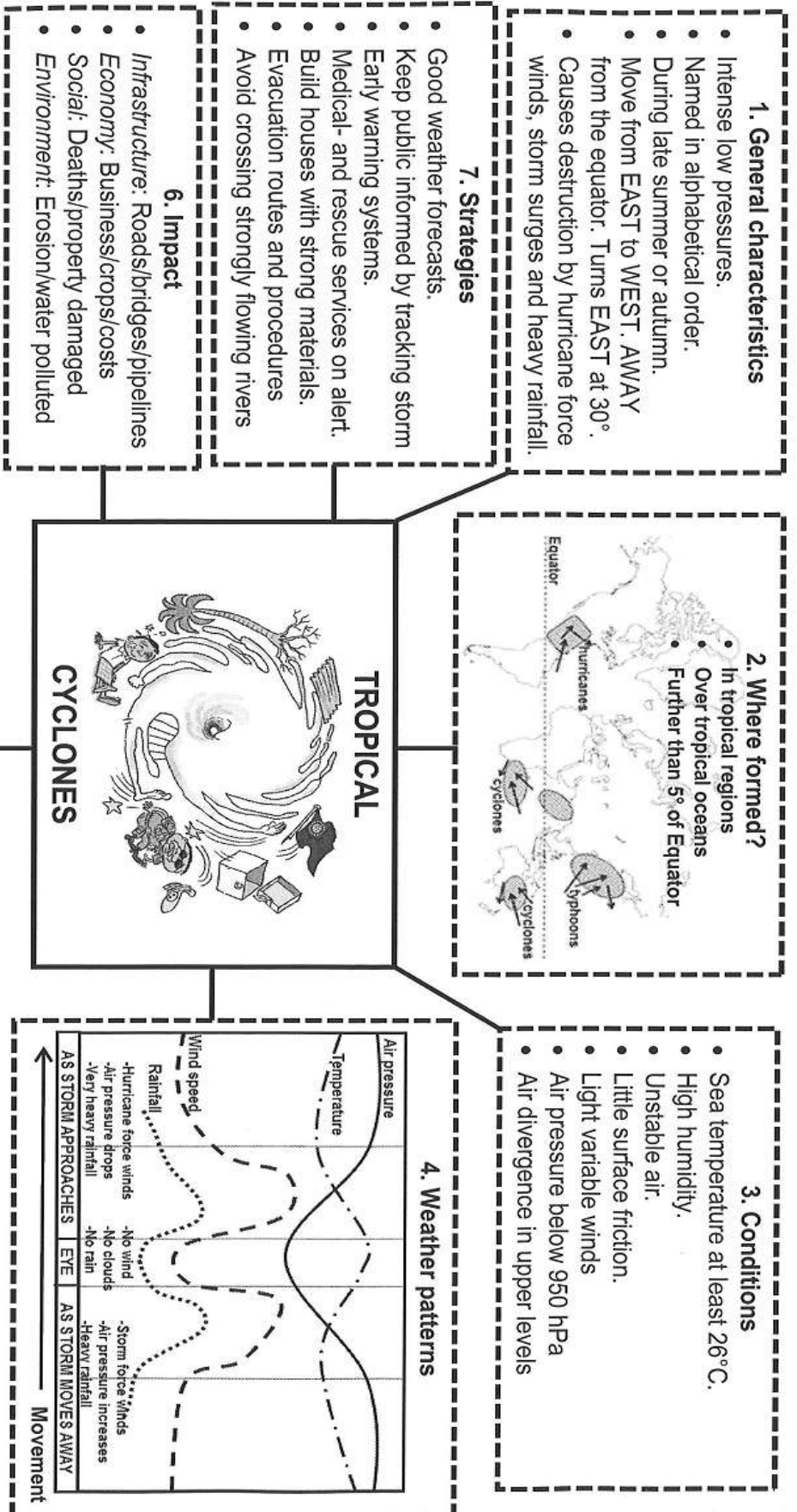
**QUESTION 2: 25 minutes [30] (Taken from NSC Nov 2013 Paper 1)**



[Source: Adapted from SA Weather Bureau]

- 2.1 Study the synoptic weather map/chart above and answer the questions that follow.
- 2.1.1. Identify the weather system at E. (1 x 2) (2)
  - 2.1.2. State the pressure at the centre of pressure cell E. (1 x 2) (2)
  - 2.1.3. Identify ONE piece of evidence from the synoptic map/chart to indicate that it represents winter conditions. (1 x 2) (2)
  - 2.1.4. Name the front at C. (1 x 2) (2)
  - 2.1.5. In which direction will C move and explain why. (2 x 2) (4)
  - 2.1.6. Use the enlarged station model on the right side of the map to describe the weather at Port Elizabeth at the time the map information was observed. Refer to 5 different weather elements. (5 x 1) (5)
  - 2.1.7. State how the weather elements listed in 1.1.6 will change in the next few hours in Port Elizabeth. (5 x 1) (5)
  - 2.1.8. Write a paragraph (approximately 12 lines) explaining why the weather systems identified in 1.1.1 will only influence the weather in South Africa in winter. (4 x 2) (8)

# SESSION 2 - TOPIC 2: TROPICAL CYCLONES



## SECTION A: CONTENT NOTES ON TROPICAL CYCLONES

### TERMINOLOGY / DEFINITIONS

**Tropical Cyclone:** a rapidly-rotating storm system characterized by a low-pressure centre, strong winds, and a spiral of thunderstorm clouds that produce heavy rain

**ITCZ:** Inter Tropical Convergence Zone – area around the heat equator where intense heat causes convection and convergence of the tropical easterly winds.

**Coriolis force:** The force caused by different rotation speeds along latitudes of the earth. It deflects winds to the left of its original direction in the Southern hemisphere and to the right in the Northern hemisphere.

**Vortex:** A spiral motion of air in the centre of a tropical cyclone. It is a whirling mass air that sucks everything near it toward its centre.

**Eye of cyclone:** Calm clear centre of a tropical cyclone where air is sucked down and heats adiabatically. No rain, wind or clouds occur here.

**Eye wall:** The mass of clouds, heavy rain and strong winds around the eye of a tropical cyclone where the most extreme weather conditions prevails,

**Latent Heat:** Heat released during condensation which contributes to the instability of air and convection.

**Adiabatic heating:** temperature of a moving air mass increase with  $1^{\circ}\text{C}/100\text{m}$  that it subsides. This is how the air in the eye heats up as it is sucked down.

**Storm surge:** an abnormal rise in the level of the sea along a coast caused by the onshore winds and intense low pressure of a severe cyclone.

**Upper air divergence:** air in the upper atmosphere move outward, causing a low pressure which drag air upward and intensifies low pressure conditions on the surface.



**STUDY TIPS:** Know the definitions, stages of development, impact and possible prevention methods. Make sure you can differentiate between mid-latitude cyclones and tropical cyclones on synoptic weather maps and identify and describe each.

## 2. TROPICAL CYCLONES

### 2.1. GENERAL CHARACTERISTICS

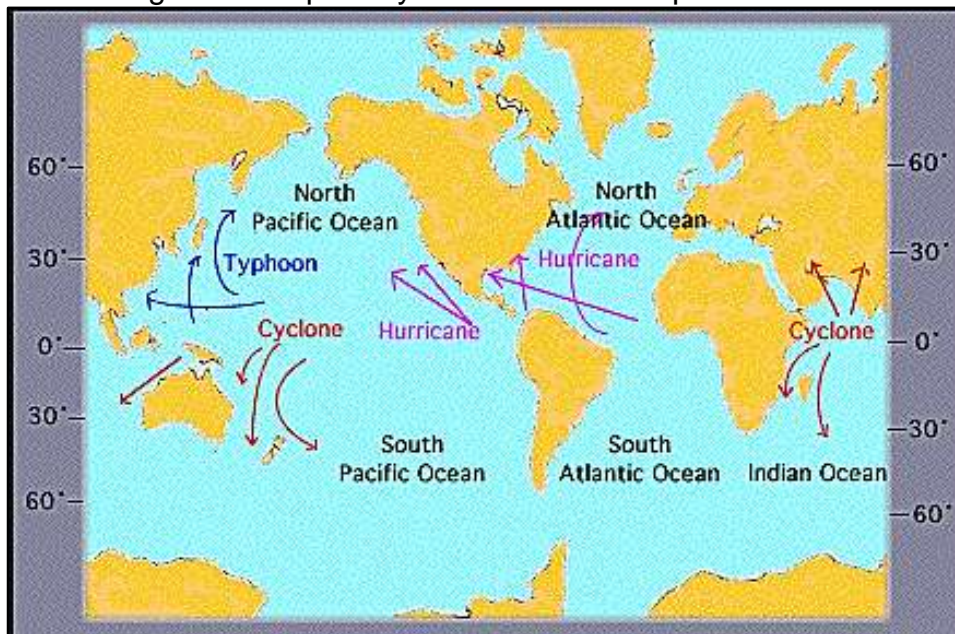
- Intense low pressure spiralling storms that develop over tropical oceans hit the east coast of continents
- About 600 km in diameter in mature stage (smaller than MLC)
- Low pressure in centre is so intense that an eye develops where a vortex sucks down air to form an eye
- The air in the eye heats up adiabatically as it moves down
- Associated with torrential rain (heavy continuous rain) which causes flooding.

- Hurricane strength winds which cause large swells at sea and a storm surge which floods coastal areas.
- The storm surge and consequent flooding is responsible for 9/10 deaths associated with tropical cyclones
- Named alphabetically per season
- Occur in late summer and early autumn – when sea water in the area has reached its highest temperatures
- Develop over warm oceans
- Strikes the East coasts of continents in the tropical areas

## 2.2. AREAS OF FORMATION AND ASSOCIATED TERMS

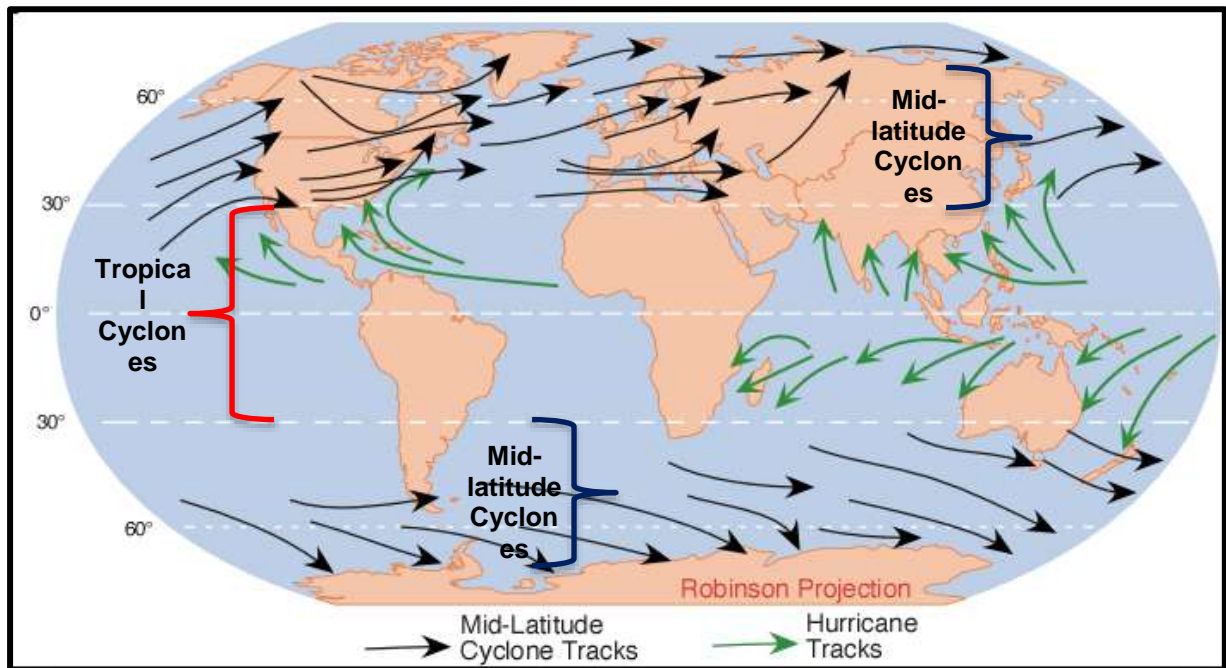
- Start at the ITCZ (Inter Tropical Convergence Zone)
- Start outside 5° N & S as it needs Coriolis force
- Do not develop on the Equator due to the lack of Coriolis force
- Dissipate over land and outside 30° N & S
- Develop in the Tropical / Hadley circulation cell
- Occur in the Tropical Easterly wind belts and move from East to West with the tropical Easterlies
- Develops over oceans masses with temperatures <27°C

The names given to tropical cyclones in different parts of the World



The areas affected by Tropical cyclones and mid-latitude cyclones respectively





<http://www.physicalgeography.net/fundamentals/7s.html>

### 2.3. CONDITIONS NECESSARY FOR FORMATION

- Tropical cyclones develop over the sea in the tropical areas.
- The water must be warmer than 27°C which
- Large scale evaporation forms very hot, humid, unstable air.
- The hot air starts rising and forms an intense low pressure on the surface.
- The tropical jet stream causes an upper air divergence and this intensifies the low pressure on the surface.
- Air is sucked into the low pressure – strong pressure gradient – fast winds
- Outside 5°N 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.
- 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.

### 2.4. STAGES IN THE FORMATION

#### STAGE 1: FORMATIVE STAGE

- Very strong up draughts which cause a low pressure to develop.
- The cyclone is not very large yet and there is no clear eye yet.
- The gale force winds start spiralling.
- Not very large yet and no clear eye

#### STAGE 2: IMMATURE STAGE

- Low pressure intensifies to less than 1000 hPa
- Wind speed increases to hurricane strength
- Increase in size and the eye start to develop.

This sketch illustrates the different stages in the development of a hurricane in the northern Atlantic Ocean.



[ed101.bu.edu/StudentDoc/Archives/ED101fa06/mattwall/Weather Geography.html](http://ed101.bu.edu/StudentDoc/Archives/ED101fa06/mattwall/Weather%20Geography.html)

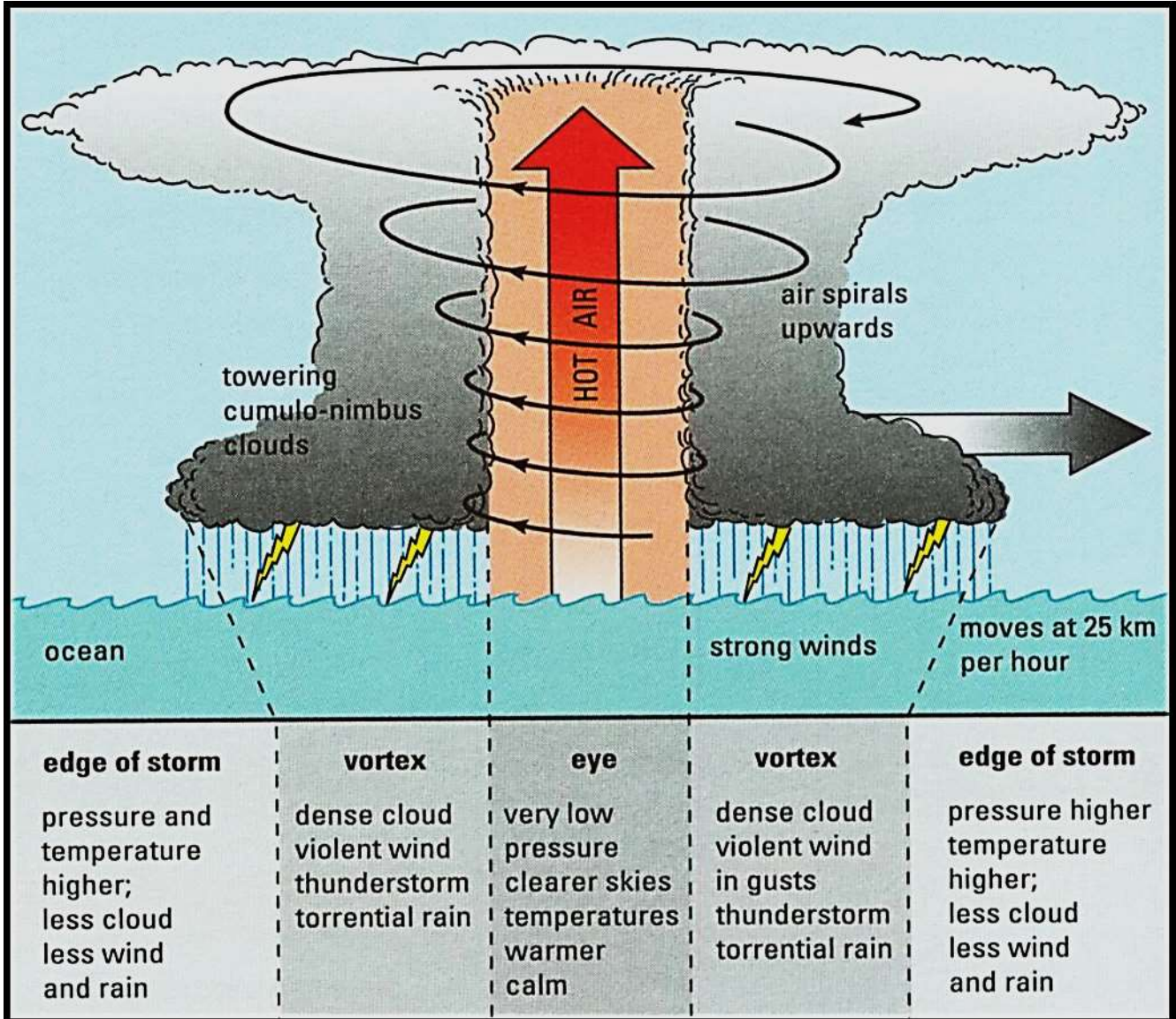
### STAGE 3: MATURE STAGE

- The pressure gradient is very strong and wind speeds reach hurricane strength
- The calm, clear eye is well developed
- Air pressure is less than 950hPa.
- The South Western quadrant is the most destructive as the winds and the Tropical Easterly winds are coinciding.
- Large - 300km from the eye.
- Moves South West from the equator then turns South East at about 20° 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.

### STAGE 4: DISSIPATING STAGE

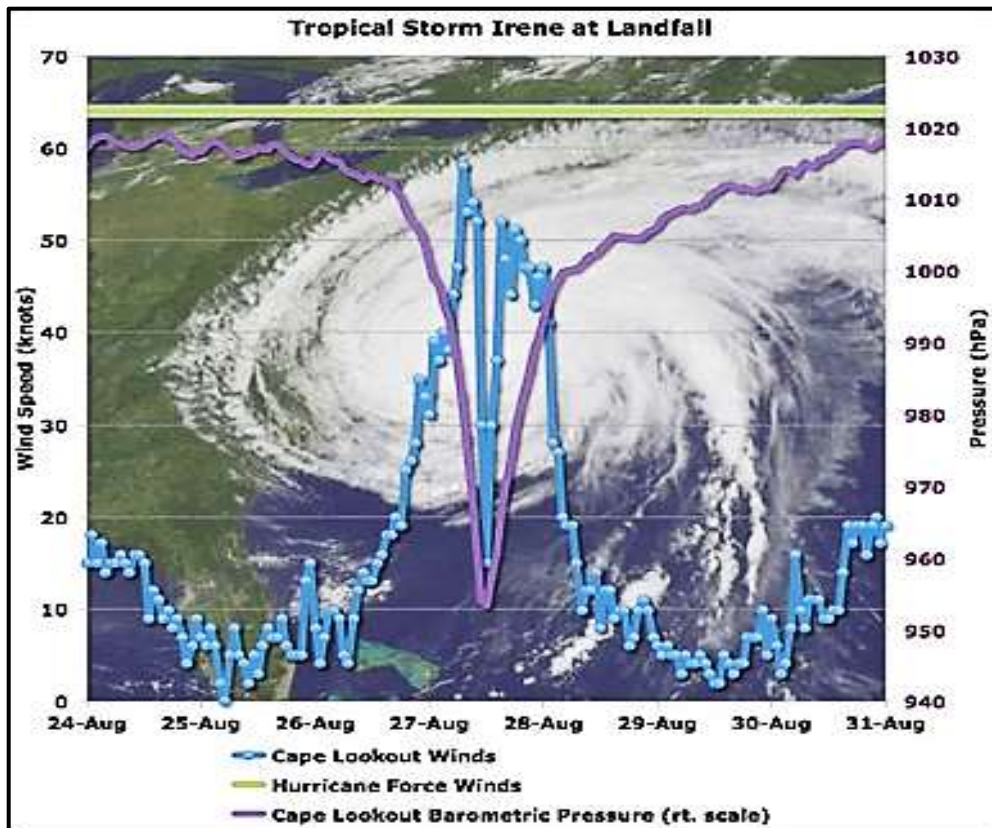
- Tropical cyclone moves over land
- Wind is slowed down by friction
- Less evaporation over land and over cooler ocean masses
- Moves into cooler sub-tropical areas and the air pressure increases
- Stable air conditions returns
- The weather clears up

### 2.5. ASSOCIATED WEATHER PATTERNS



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

The graph below shows the drop in air pressure towards the centre of the cyclone and the increase and the sudden drop in winds in the eye.



## 2.6. IMPACT ON HUMAN ACTIVITIES AND THE ENVIRONMENT (INCLUDING IMPACT OF FLOODS)

### Human impact

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

### Environmental impact

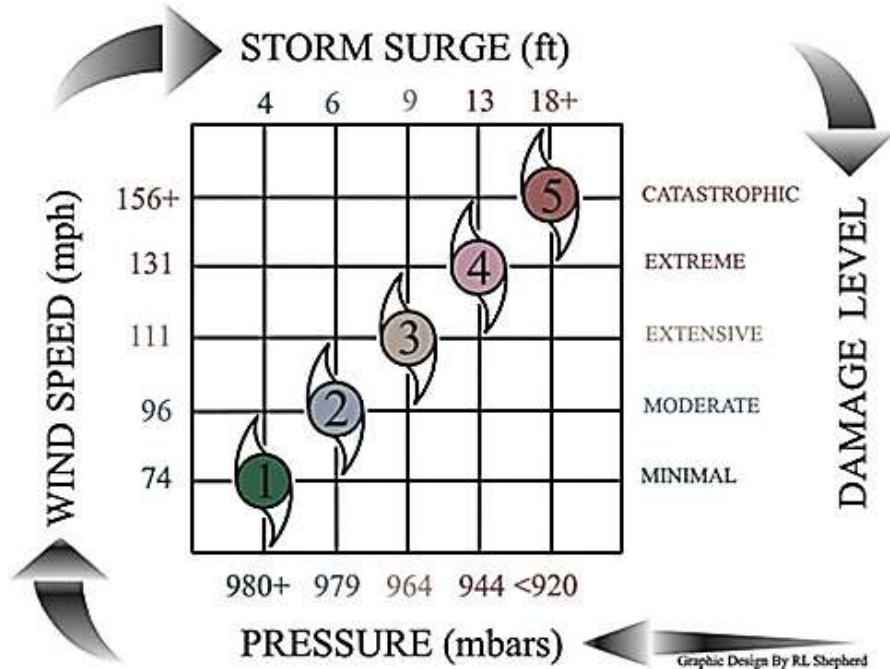
- Heavy rain – flooding of habitats
- Erosion due to flooding
- Flooding by the ocean surge (bulge of sea water under the Low Pressure)
- Wind damage

## 2.7. Pre-cautionary and management strategies to manage the effect of tropical cyclones (including floods)

- Research to improve forecasting
- Improve early warning systems
- Evacuation and disaster management plans
- Do not allow new development in cyclone prone areas
- Breakwater walls to reduce flooding from storm surge
- Build away from the coastline

The Saffir-Simpson Scale shows the classification of tropical cyclones according to the intensity of the storm. This helps with the decision to evacuate and area.

## SAFFIR-SIMPSON HURRICANE SCALE



### 2.8 IDENTIFICATION ON SYNOPTIC WEATHER MAPS AND SATELLITE IMAGES

The satellite image show cyclone Felleng in the mature stage with a well-developed eye East of Madagascar. Take note of the clockwise movement of the spiralling winds and cloud bands as it occurred in the Southern Hemisphere.



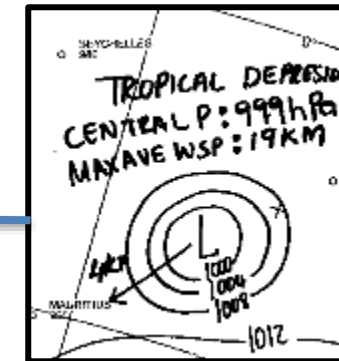
### 2.9. IDENTIFICATION OF STAGES OF DEVELOPMENT ON SYNOPTIC WEATHER MAPS

#### 2.10

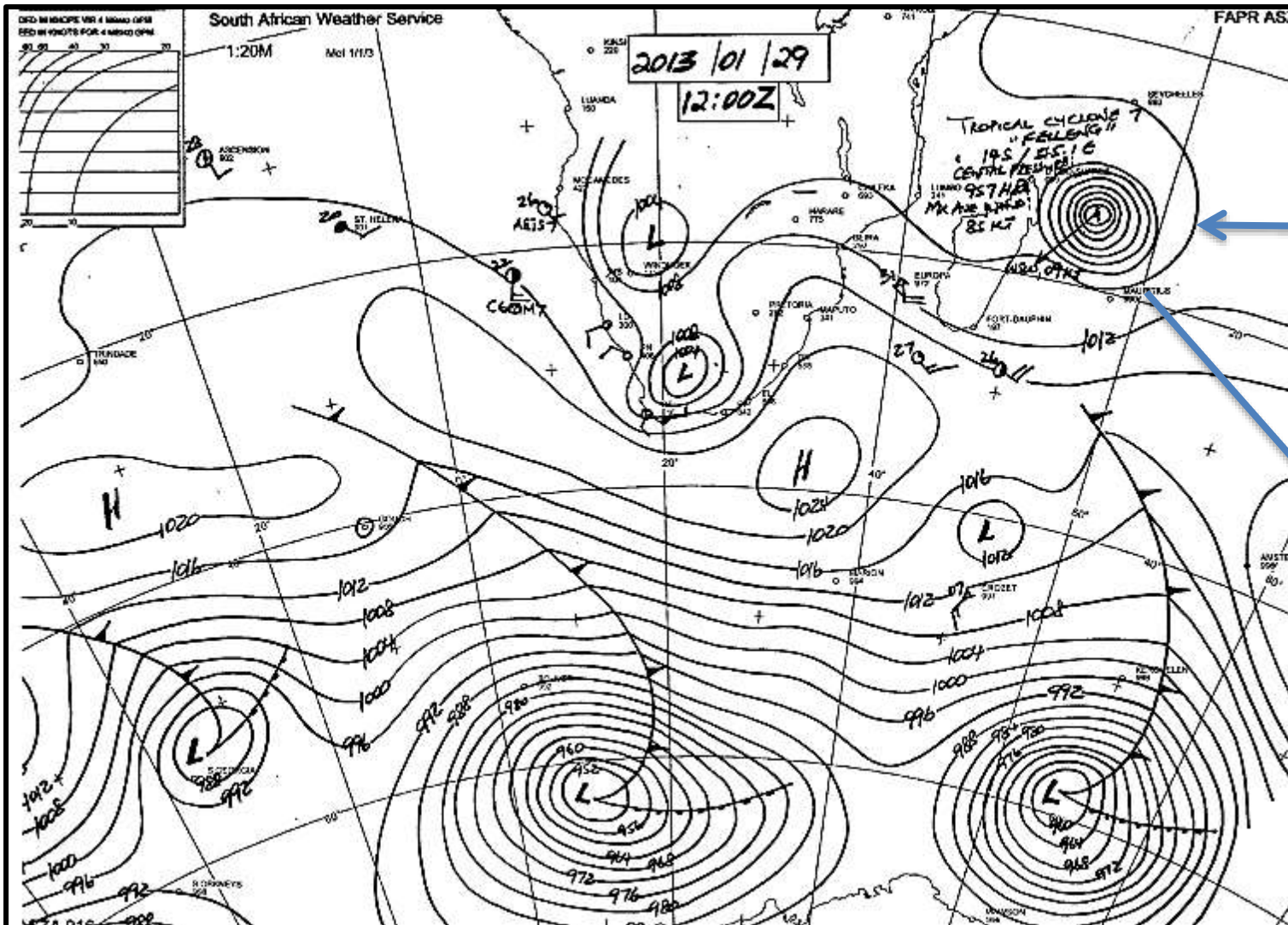
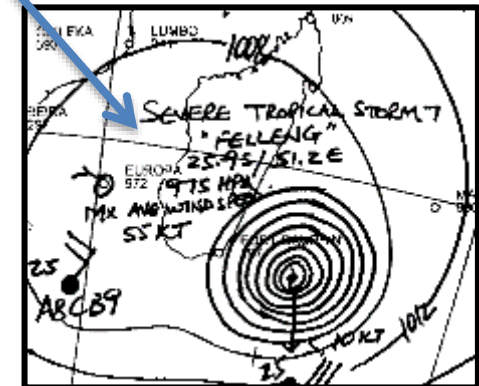
The synoptic map and clips below illustrate the development stages of Felleng.

The development of cyclone Felling – February 2013

Immature stage  
26 February 2013

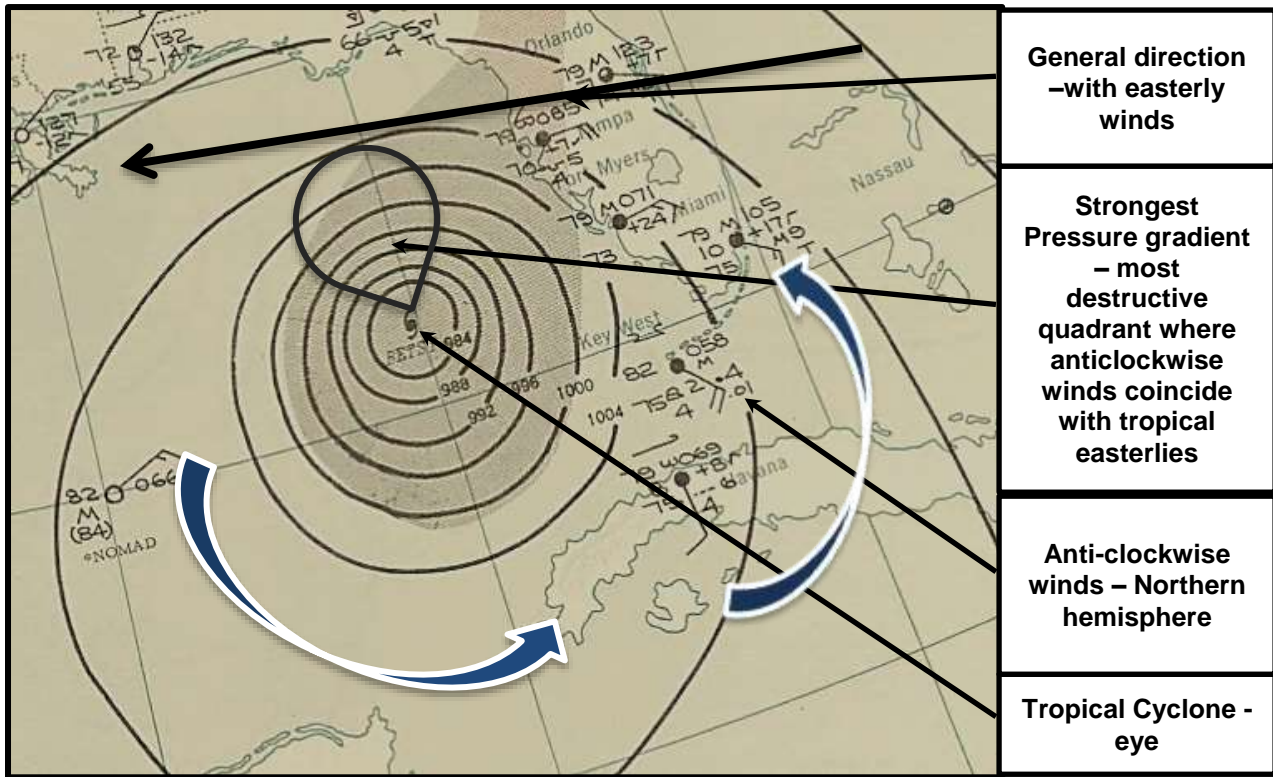


Mature Stage  
2 March 013



<http://sageodaphny.myschoolstuff.co.za/geogwiki/synoptic-chart-examples/tropical-cyclone-felling-2013/>

## 2.11 INTERPRETATION OF WEATHER SYMBOLS



[http://en.wikipedia.org/wiki/File:Hurricane\\_Betsy\\_analysis\\_9\\_Sep\\_1965.png](http://en.wikipedia.org/wiki/File:Hurricane_Betsy_analysis_9_Sep_1965.png)

### 2.11 CASE STUDY OF ONE RECENT TROPICAL CYCLONE THAT

The exams often have a short newspaper article and maps or satellite images of a recent tropical cyclone. Read as many newspaper articles and case studies you can find and answer the questions in the textbooks on this.

## SECTION B: TYPICAL EXAM QUESTIONS ON TROPICAL CYCLONES

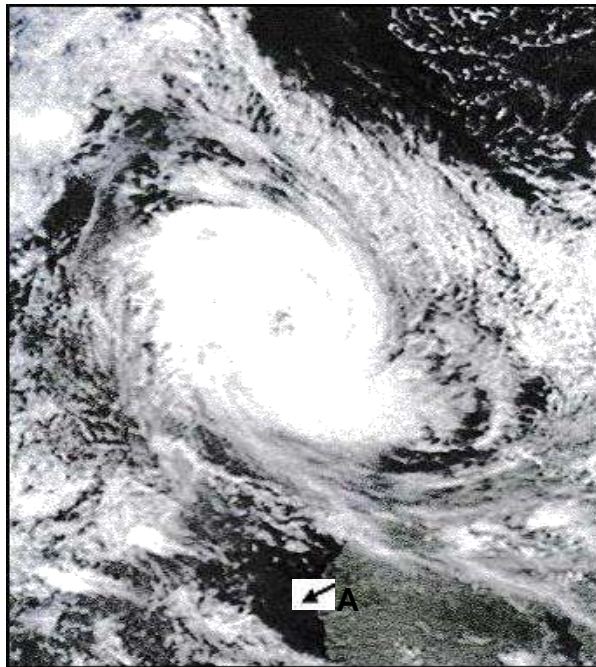
### Tropical cyclone

#### FIGURE 1. TROPICAL CYCLONE (exemplar 2014)

##### TROPICAL CYCLONE HARUNA

Tropical cyclone Haruna developed in the Mozambique Channel on 18 February 2013. It reached a peak wind speed of 150 km per hour. It weakened significantly when it reached land, where a previous system had already flooded the land. When

Haruna arrived, 7 402 houses were destroyed, rice and maize crops were damaged, 26 people were killed, 127 injured and there was an outbreak of disease after the tropical cyclone dissipated. It dissipated on 24 February 2013.



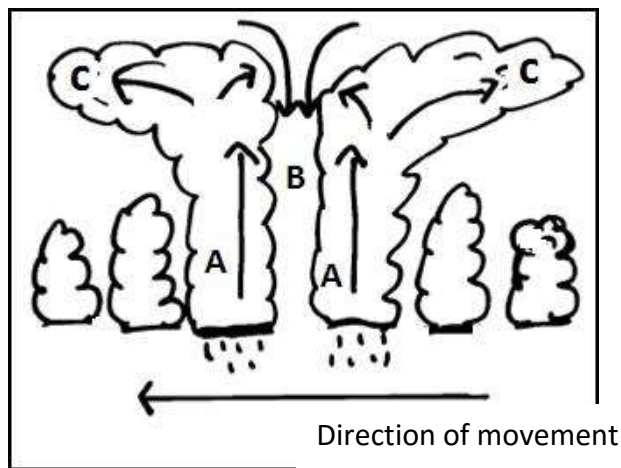
[Source: South African Weather Service]

- 1.1. Study the information and satellite image on tropical cyclone Haruna in FIGURE 1.3 and answer the questions that follow.
  - 1.1.1. Name the centre of the tropical cyclone labelled **A** on the satellite image. (1 x 1) (1)
  - 1.1.2. State the direction in which the clouds are turning/rotating around the centre of the tropical cyclone. (1 x 1) (1)
  - 1.1.3. What was the lifespan (time of existence) of tropical cyclone Haruna? (1 x 1) (1)



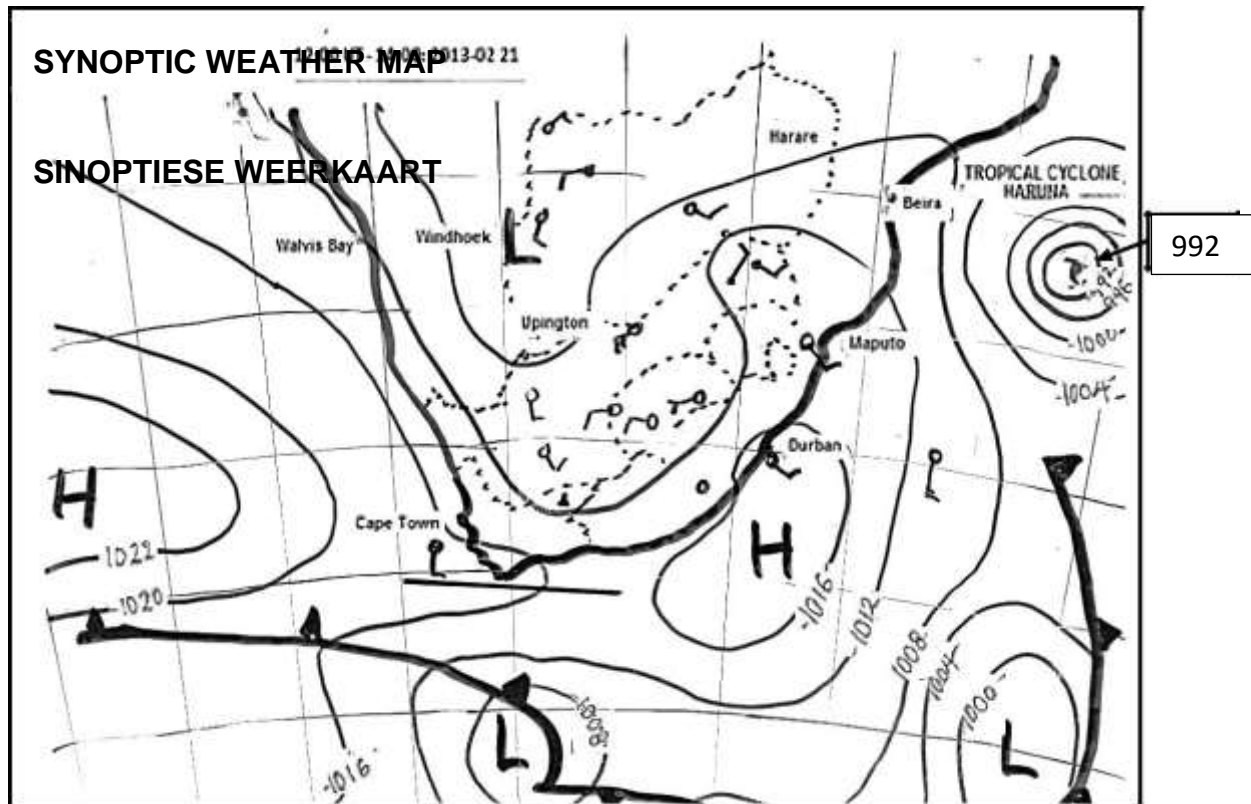
- 1.1.4. How many tropical cyclones, including Haruna, have Mozambique already experienced for the season? (1 x 2) (2)
- 1.1.5. Give ONE reason why tropical cyclone Haruna weakened when it moved over Madagascar. (1 x 2) (2)
- 1.1.6. Evaluate why the impact of a tropical cyclone is more severe in a country like Mozambique than in developed countries. (4 x 2) (8)

**FIGURE 2: CROSS-SECTION OF A TROPICAL CYCLONE (November 2014)**



- 2.1. Study FIGURE 2 based on a cross-section of a tropical cyclone and answer the questions that follow.
- 2.1.1. Name cloud type **A**.
- 2.1.2. What is the name given to area **B** in the tropical cyclone?
- 2.1.3. Is the air pressure high or low in area **B**?
- 2.1.4. In which general direction do tropical cyclones travel in the Southern Hemisphere?
- 2.1.5. State the precipitation associated with cloud **A**.
- 2.1.6. Name the air movement in area **B**.
- 2.1.7. Is the air converging or diverging in area **C**?
- 2.1.8. What is the name given to the stage of development when a tropical cyclone moves inland? (8 x 1) (8)

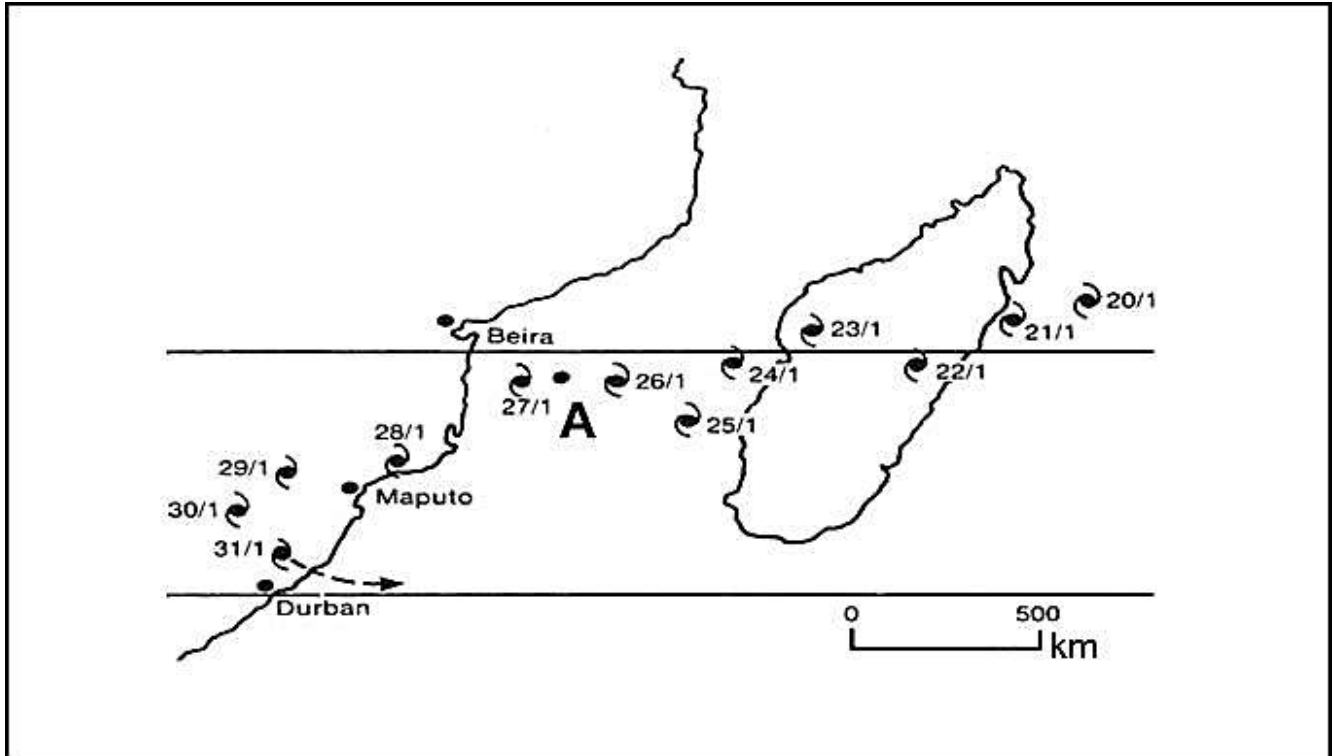
FIGURE 3: SYNOPTIC WEATHER MAP



[Source: South African Weather Bureau]

- 3.1. Study FIGURE 3 which shows a synoptic weather map.
  - 3.1.1. Does the map show a typical summer or winter condition? (1 x 1) (1)
  - 3.1.2. Draw the symbol present on the synoptic weather map indicating the eye of Tropical Cyclone Haruna. (1 x 1) (1)
  - 3.1.3. What evidence suggests that Tropical Cyclone Haruna is in its mature stage? (1 x 2) (2)
  - 3.1.4. Describe the weather associated with the eye of the cyclone. (2 x 2) (4)
  - 3.1.5. How do warm oceans contribute to the development of these cyclones? (1 x 2) (2)
  - 3.1.6. Suggest TWO precautions the people of Maputo need to take within the next 24 hours. (2 x 2) (4)

FIGURE 4: TROPICAL CYCLONE (2015 June)



4.1. Study FIGURE 4 which shows the path of a tropical cyclone in the Mozambique Channel.

4.1.1 In which general direction do tropical cyclones move? (1 x 1) (1)

4.1.2 The Coriolis Force is almost zero between 0° and 5° south and north of the equator. How will this impact on the point of origin of a tropical cyclone? (1 x 2) (2)

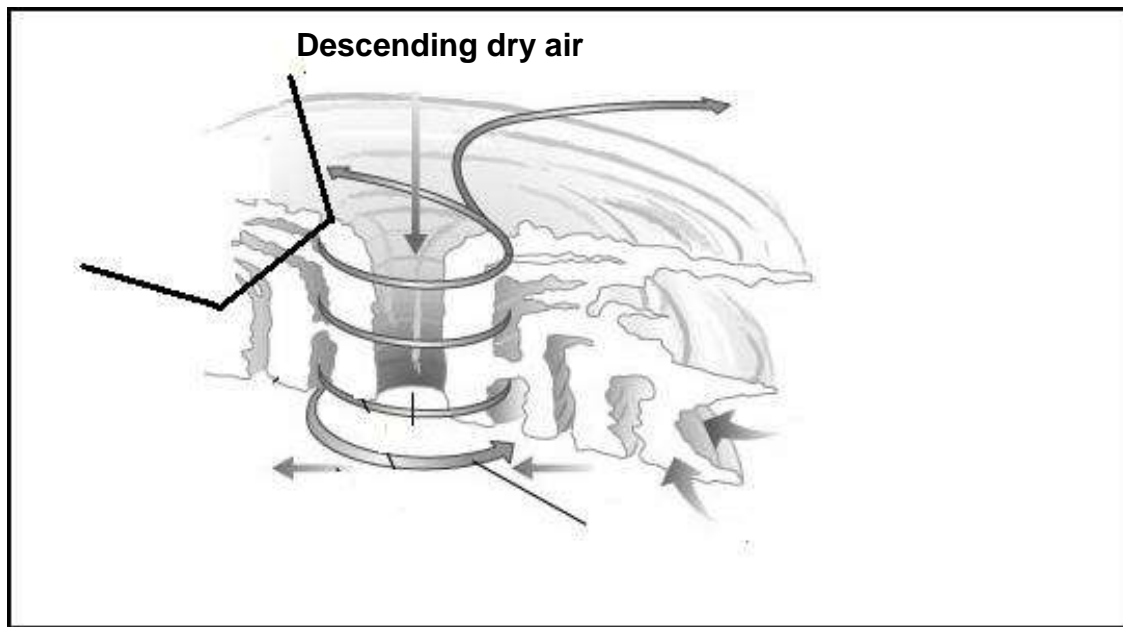
4.1.3. Give the duration in days of the tropical cyclone in FIGURE 4. (1x 2) (2)

4.1.4. Use the scale provided to determine the approximate distance of the path taken by this cyclone between 20 January and 31 January. (1 x 2) (2)

4.1.5. Why do tropical cyclones follow an erratic path? (2 x 2) (4)

4.1.6. A ship at A was caught in the dangerous semicircle of the tropical cyclone. Predict the consequences for this ship that was caught in the cyclone in terms of the safe delivery its cargo to the Durban harbour. (2 x 2) (4)

**FIGURE 5: CYCLONE (2015 November)**

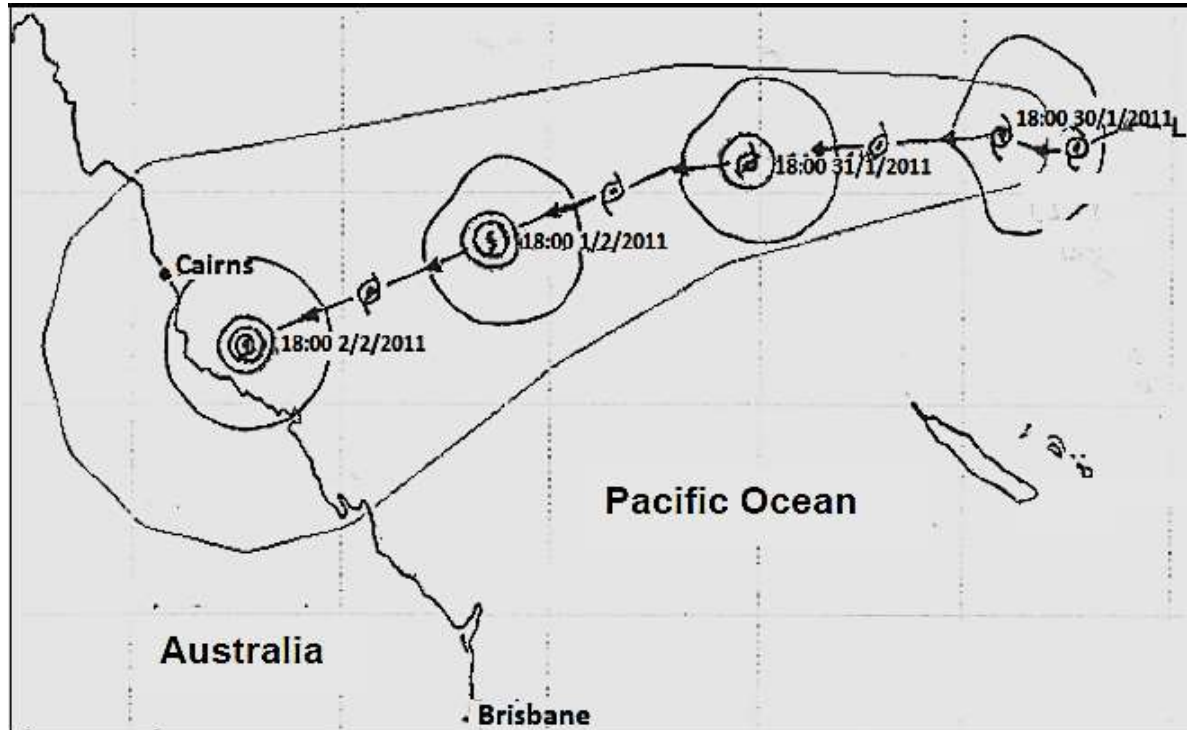


- 5.1. Study the cyclone in FIGURE 5 and answer the questions that follow.
- 5.2.
- 5.1.1 Give evidence to indicate that the sketch shows a cyclone in the Northern Hemisphere. (1 x 1) (1)
- 5.1.2 Name the section of the moving cyclone where the highest wind speeds are recorded. (1 x 1) (1)
- 5.1.3 Give ONE reason why the descending (sinking) air in the eye is dry. (1 x 2) (2)
- 5.1.4 Explain why satellite images are effective for tracking cyclones. (2 x 2) (4)
- 5.1.5. Write a paragraph of approximately EIGHT lines to outline the economic and environmental impact of cyclones such as the one in FIGURE 5. (4 x 2) (8)

**SECTION C: HOMEWORK QUESTIONS ON TROPICAL CYCLONES**

**QUESTION 1: 30 minutes [34] (Taken from NSC Nov 2011 Paper 1)**

Study the map below and the adapted newspaper article to answer the questions below.



**CYCLONE YASI STRIKES AUSTRALIA**

A category 5 cyclone tears roofs, pubs and houses, topples trees and sends power cables crashing on to roads.

The residents of Australia are assessing the damage after cyclone Yasi, the largest Tropical storm to strike Australia since Europeans first settled there, created winds of 280 km/h and waves more than 9 m high.

Thousands of the 400 000 people living in the path of the 500 km wide cyclone spent a sleepless night in hot and crowded emergency evacuation centres set up in primary schools and shopping centres deemed strong enough to withstand the cyclone and avoid storm surges up to 8 m high.

On Mission Beach power cables crashed on to the roads and mature trees and palms were toppled by surging winds but local residents also reported an unusual half-hour in the eye of the storm. 'It's the strangest thing to go outside and see the stars and there is no wind for half an hour.'

1. Refer to the figure and article above which captures and describes the path and effect of tropical cyclone Yasi.

- 1.1. On what date did cyclone Yasi strike the coast of Australia? (1 x 2) (2)
- 1.2. Name TWO conditions that would have favoured the development of Yasi. (2 x 2) (4)
- 1.3. What evidence from FIGURE 1.3 suggests that cyclones are common in Australia? (1 x 2) (2)
- 1.4. Explain what you understand by a *category-five cyclone*. (2 x 2) (4)
- 1.5. Refer to the statement 'local residents reported an unusual half-hour in the eye of the storm'.
  - (a) Why do they describe the weather conditions in the eye as unusual? (2 x 2) (4)
  - (b) Explain what causes the unusual conditions in the eye. (1 x 2) (2)
- 1.6. Explain and what a storm surge is and describe it. (2 x 2) (4)
- 1.7. Why do you think Australia would have an efficient emergency programme ready to handle natural hazards? (1 x 2) (2)
- 1.8. Explain why the cyclone hit Australia from the East. (1 x 2) (2)
- 1.9. Write a paragraph to explain why cyclone Yasi dissipated from the 2<sup>nd</sup> of February 2011 onward. (4 x 2) (8)

**QUESTION 2: 35 minutes**



[40]

(Taken from NSC Nov 2013 Paper 1)

**CYCLONE IRINA CAUSES CHAOS IN KZN**

5 March

By Lungelo Mkamba, Kyle Venkess and Sapa

Hundreds of families have been left homeless and many roads and streets in Durban and other coastal areas north of the city right up to Kosi Bay were turned into raging rivers as tropical cyclone Irina caused chaos across the province. The weather services said that gale-force south-westerly winds (65 km/h) were expected on Monday. There was a warning of very rough seas with waves up to 6 m.

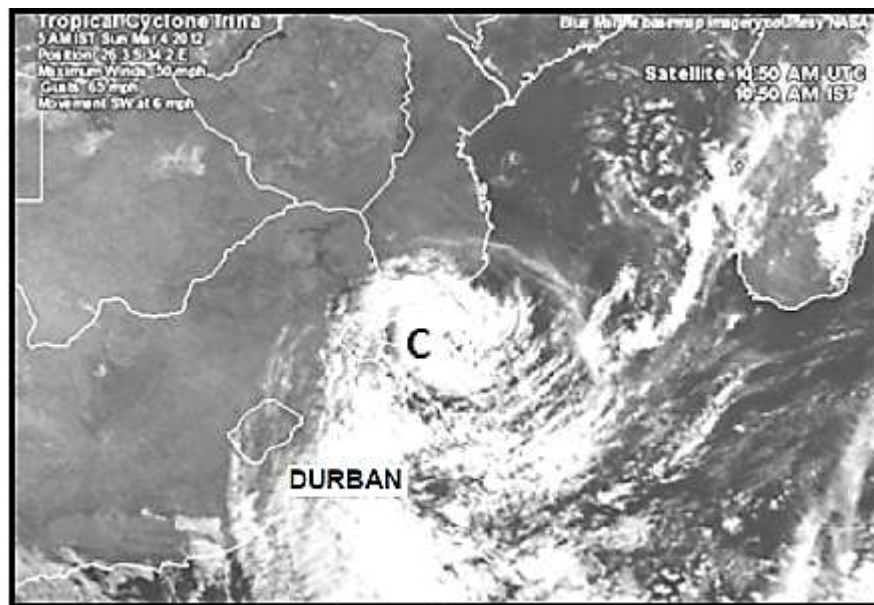
'A combination of very rough seas, marine storm surge, as well as gale-force winds was likely to threaten the coastline,' said police spokesperson Colonel Vishnu Naidoo. In Jozini in the Nyawushadi area a house collapsed on a woman, breaking her legs, after floods hit northern KwaZulu-Natal on Sunday morning.

Disaster teams were still quantifying the damage, but Naidoo estimated that at least 300 houses had been flooded.



Figure  
1 -  
2 March

Figure 2  
4 March 2012



[Source: Adapted from [www.wunderground.com](http://www.wunderground.com)]

2. Read the article above and study the satellite image based on cyclone Irina and answer the questions that follow.
  - 2.1. How many cyclones, including Irina, have occurred so far in this tropical cyclone season? (1 x 2) (2)
  - 2.2. What evidence on the satellite images suggests that Irina is a tropical cyclone? (2 x 2) (4)
  - 2.3. Identify the stages of development of the tropical cyclone in figure 1 and 2 respectively. (2 x 2) (4)

- 2.4. Identify the feature labelled A and describe the weather conditions experienced there. (3 x 2) (6)
- 2.5. Name the cloud type around A. (1 x 2) (2)
- 2.6. Explain THREE conditions necessary for the formation of tropical cyclones. (3 x 2) (6)
- 2.7. Explain why Irina disappeared after the 5<sup>th</sup> of March. (2 x 2) (4)
- 2.8. Explain why people in KwaZulu-Natal would not have been prepared for the chaos created by tropical cyclone Irina. Give TWO reasons. (2 x 2) (4)
- 2.9. Write a paragraph on the impact of the cyclone damage on the environment and the economy of Kwazulu Natal. (4 x 2) (8)

### SESSION 3 – TOPIC 3: SUBTROPICAL ANTICYCLONES (HIGH-PRESSURE CELLS) AND THE RESULTANT WEATHER OVER SOUTH AFRICA

#### SECTION A: NOTES ON CONTENT ON ANTI-CYCLONES IN SA

#### TERMINOLOGY / DEFINITIONS

**Anti-cyclone:** A high pressure cell

**Temperature inversion:** A layer of warm air above cooler air – a negative temperature lapse rate

**Temperature lapse rate:** temperature change with altitude

Adiabatic temperature lapse rate: how temperature of moving air masses change

**Dry adiabatic lapse rate:** the temperature of an air mass increases with 1°C/100m that it sinks and decreases with 1°C/100m when it rises.

**Wet adiabatic lapse rate:** the temperature of a rising air mass where condensation takes place drops with 0,5°C/100m as latent heat is released during condensation.

**Moisture boundary:** trough where cool dry winds SW from the South Atlantic Ocean HP meet with warm moist NE winds from the Indian Ocean HP and cause cloud formation and rain over South Africa.

**Line thunderstorms:** Thunderstorms that develop along the moisture boundary

**Coastal low pressure:** a low pressure system that develops along the coastline and cause dry conditions on the offshore side and cloudy conditions on the onshore side due to the clockwise rotation in the system.

**Bergwinds:** hot dry winds blowing down mountains heating adiabatically as it subsides. It causes hot dry uncomfortable conditions at the foothills and leads to fire hazard conditions. (Called Chinook in the Rockies and Föhn winds in the Alps)



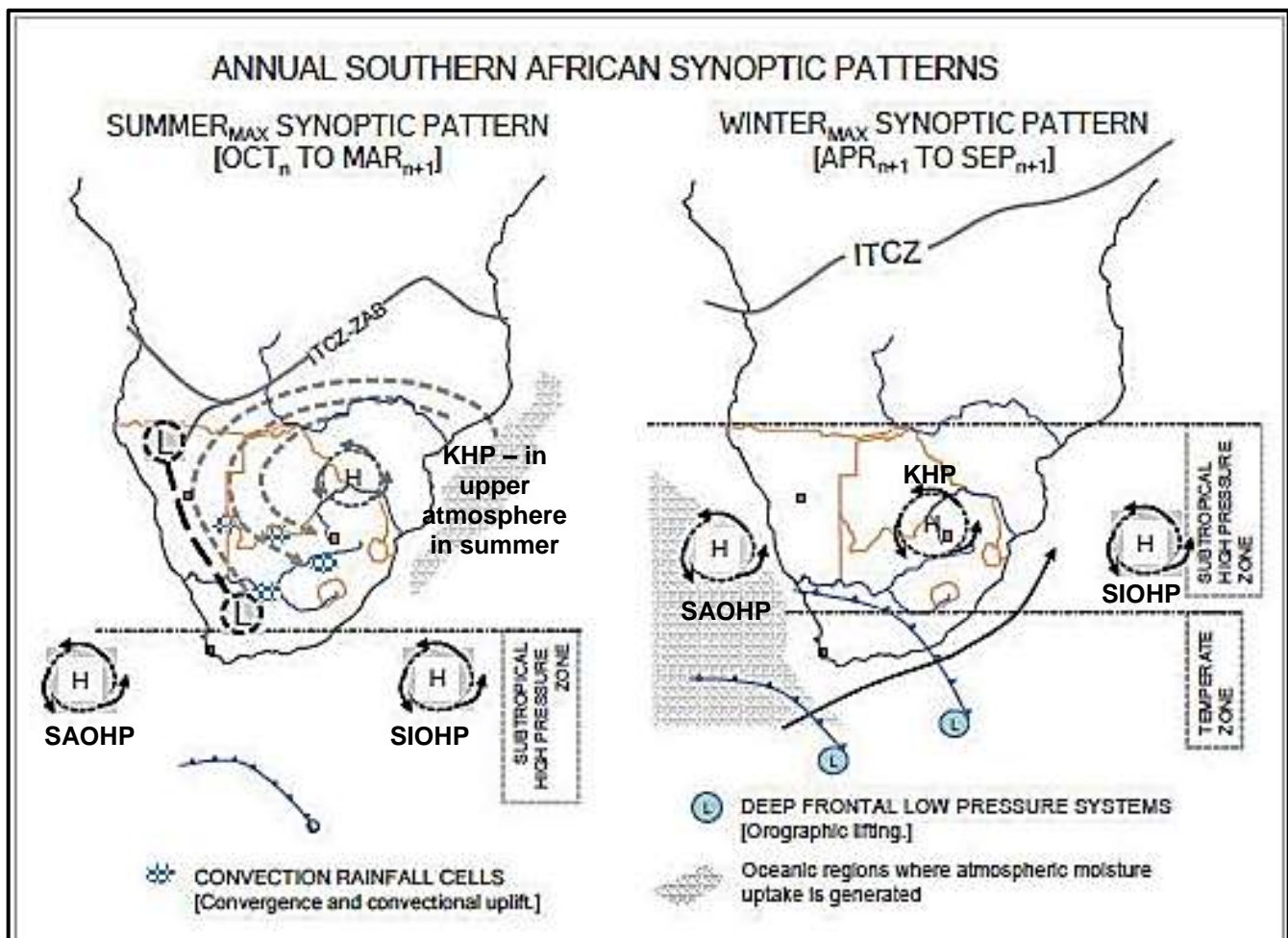
**STUDY TIPS:**

You need to know and understand how the shifting of the ITCZ leads to the shifting of the anti-cyclones which cause the different summer and winter conditions in South Africa.

Know the definitions well and make sure you can identify the different conditions on synoptic weather maps.

**1. LOCATION AND IDENTIFICATION OF THE THREE HIGH PRESSURE CELLS THAT AFFECT SOUTH AFRICA**

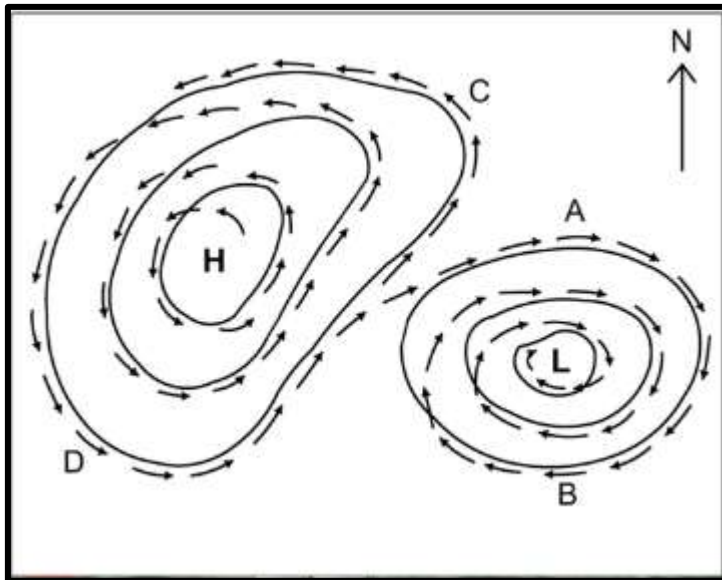
- South Atlantic/St Helena high-pressure cell (SAOHP)  
Over South Atlantic Ocean – shift N (winter) /S (summer) with direct sunlight
- South Indian/Mauritius high-pressure cell (SIOHP)  
Over South Indian Ocean - shift N (winter) /S (summer) with direct sunlight
- Kalahari/Continental high-pressure cell (KHP)  
Situating over SA plateau – well developed in winter but shift into upper atmosphere in summer and is not visible on normal synoptic maps in summer



<http://www.scielo.org.za/img/revistas/wsa/v37n2/a03fig01m.jpg>

## 2. General characteristics of the THREE high-pressure cells

- Similarities:
- Anti-clockwise rotation of air
  - Air subsides / sinks in the HP
  - Air flows away from HP on the surface of the earth
  - Sinking air heats adiabatically ( $1^\circ/100\text{m}$ ) and becomes dry
  - Stable air which do not carry a lot of moisture
  - Calm clear conditions – no clouds or precipitation



Pressure Gradient – Air move from HP to LP

Coriolis force: Wind is deflected to the left of its original direction – anti-clockwise around HP and Clockwise around LP

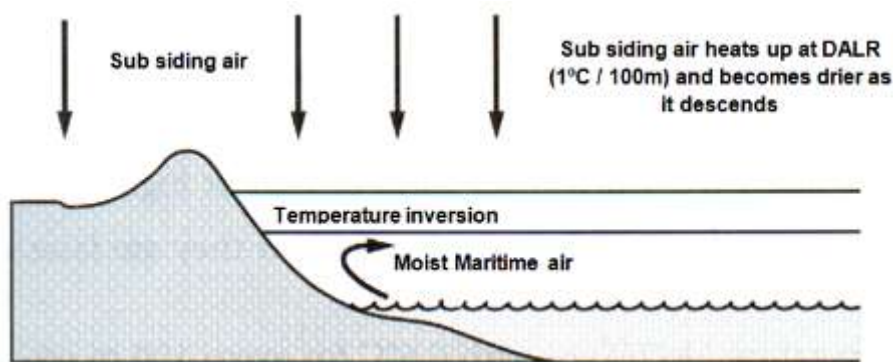
Geostrophic flow – winds blow parallel to isobars

South Atlantic/St Helena high-pressure cell	South Indian/Mauritius high-pressure cell	Kalahari/Continental high-pressure cell
Over cold Benguela current – little evaporation Pushes very dry and cool air into SA from the SW	Over warm Mozambique current – large amount of evaporation Pushes warm moist unstable air into SA from the NE	Over SA in Winter – dry stable – no precipitation (except frost on winter nights) Lift into the upper atmosphere in summer due to convection

### 3. INFLUENCE OF ANTICYCLONES ON SOUTH AFRICA'S WEATHER AND CLIMATE

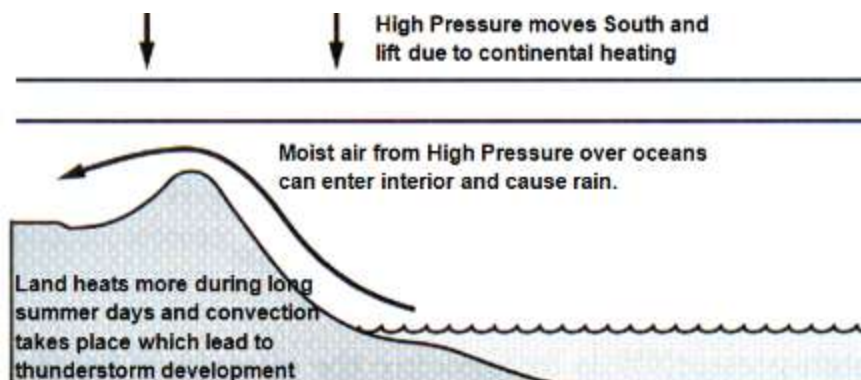
#### 3.1. WINTER WEATHER IN SA

- Dominated by the Subtropical High Pressure cells
- 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.)
- The subsiding airs in the Kalahari High Pressure Cell heats up at Dry Adiabatic lapse rate and are 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.

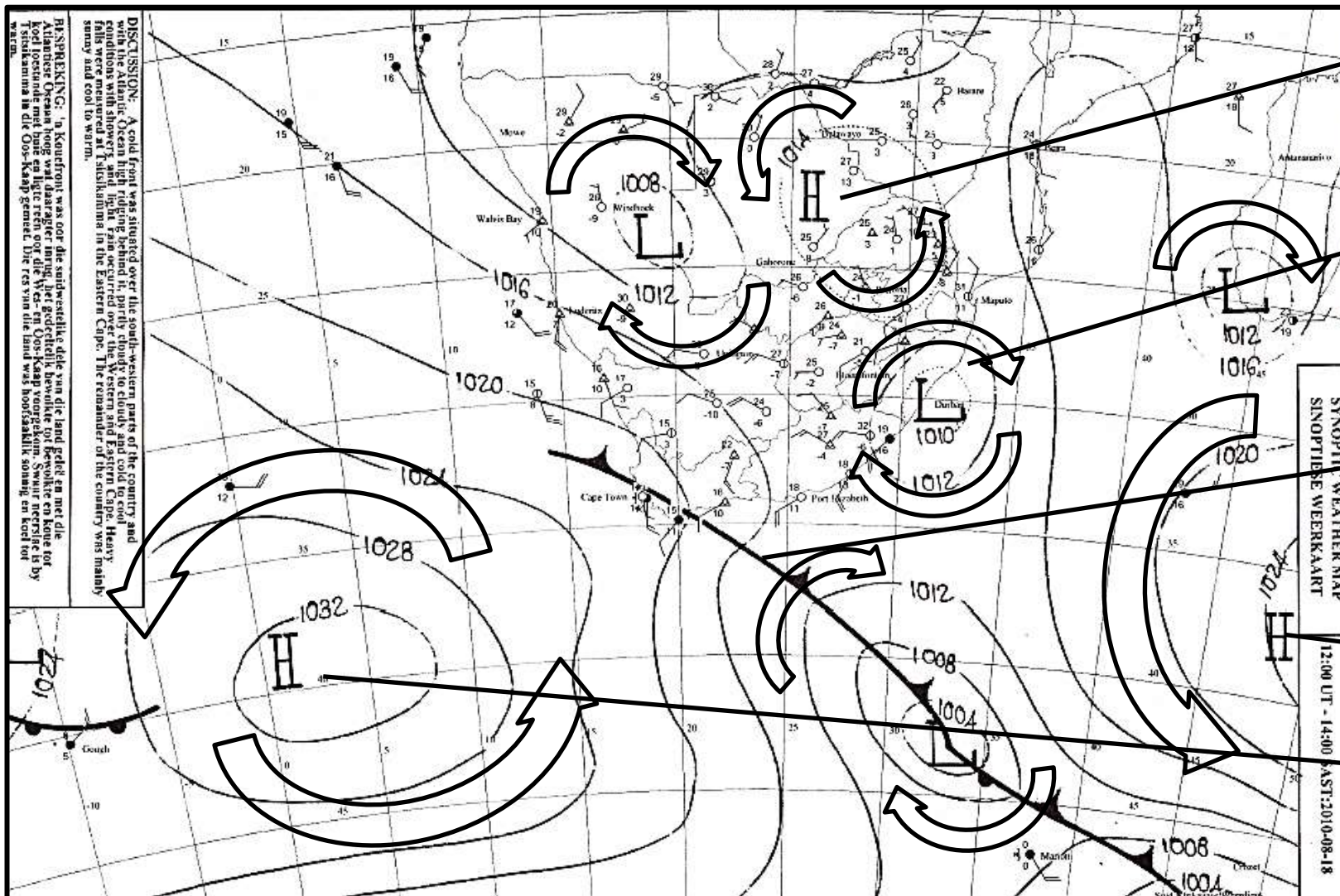


#### 3.2. SUMMER WEATHER IN SA

- Sub-tropical High pressure belt moves South with the Heat Equator.
- The Kalahari HP is lifted to above the escarpment by heating and convection.
- Low pressure system develop over the interior
- 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.



#### 4. Interpretation and reading of information related to the THREE high-pressure cells on synoptic weather maps



Kalahari HP causes dry clear condition over interior with frost at night due to fast radiation

Coastal LP – clockwise rotation cause cloudy conditions at onshore winds and warmer dry conditions at offshore side

Approaching cold front will cause cold condition over the country as it moves from west to east.

SIOHP will push MLC South

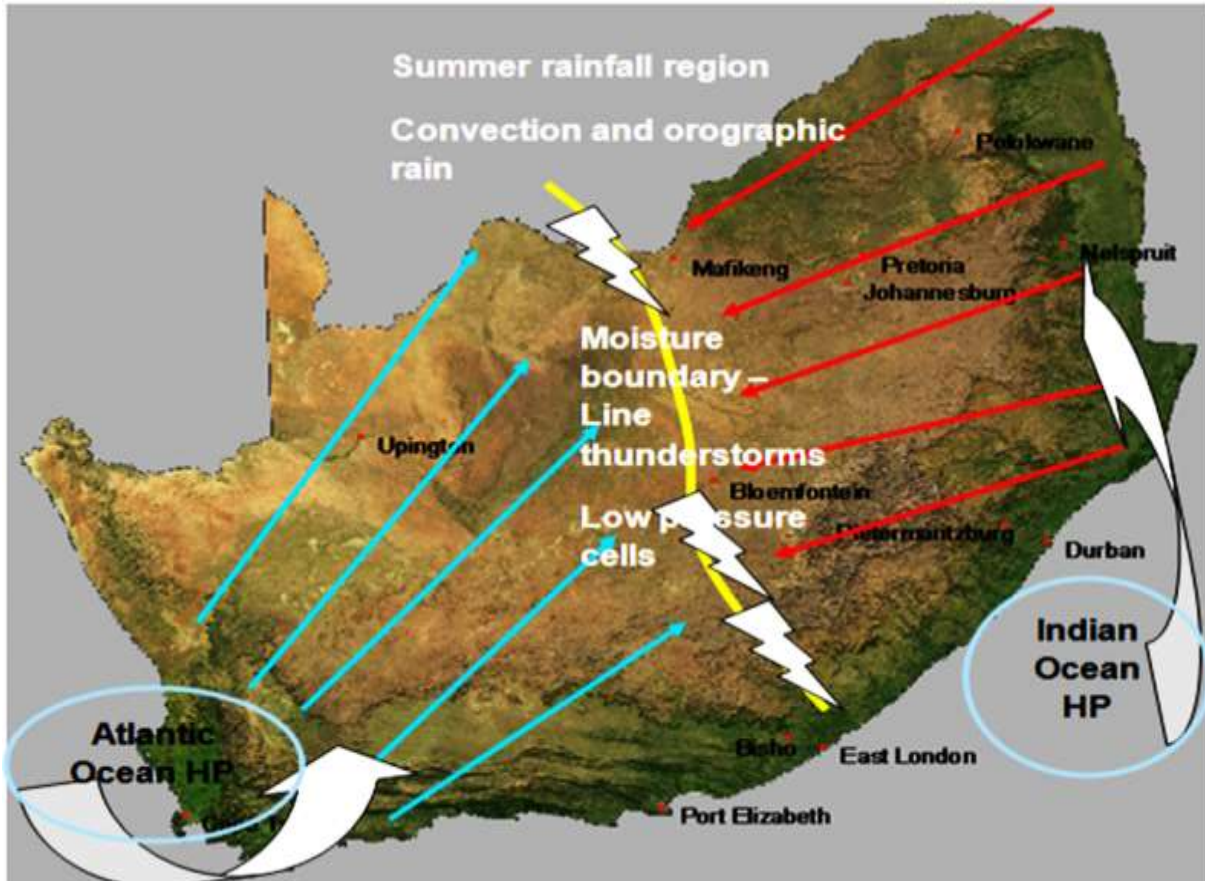
SAOHP will ridge in behind cold front and push cold air into the interior



## 5. DEVELOPMENT OF TRAVELLING DISTURBANCES ASSOCIATED WITH ANTI-CYCLONIC CIRCULATION

### 5.1. MOISTURE FRONT AND LINE THUNDERSTORMS

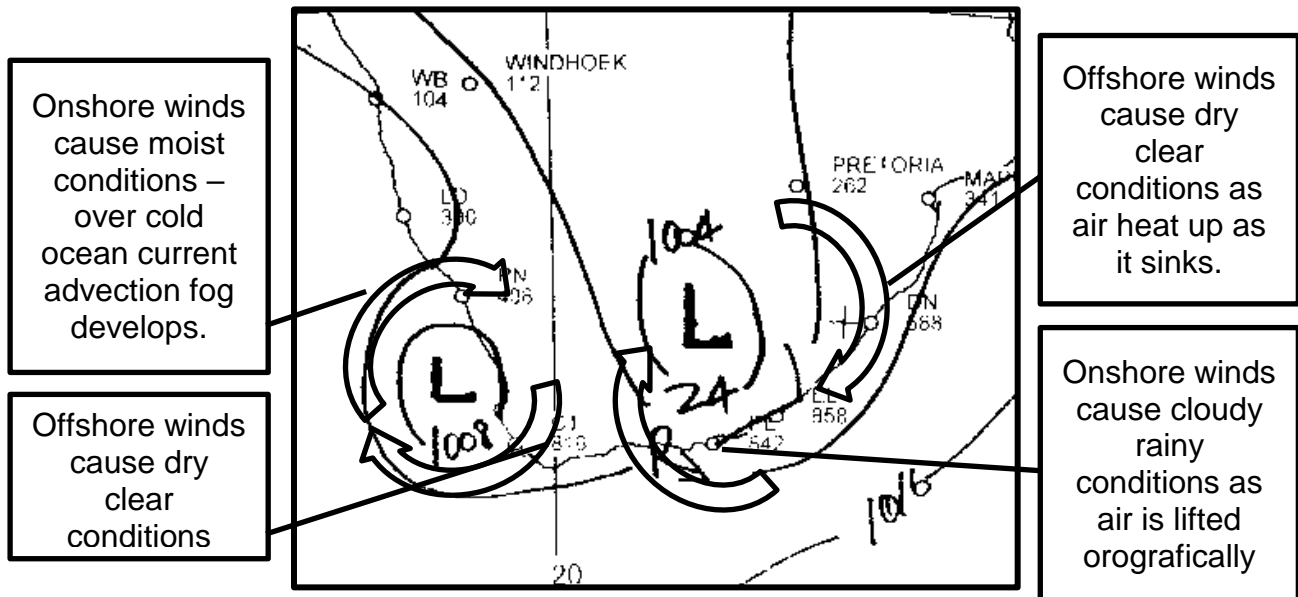
- Cool dry air from the SW is pushed into the country from the South Atlantic HP
- Warm moist air from the NE (South Indian Ocean HP)
- The moisture boundary develops in summer when the land heats up enough to cause low pressure cells in the interior of the country.
- The cool air lifts the warm air and line thunderstorms develop along the moisture boundary.



### 5.2. Coastal low pressure

- Coastal Low pressures develop during summer and winter in SA.
- These low pressure cause complete different weather on either side of the pressure cell along the coast
- The air move in clockwise direction around the cell.
- one side of the pressure cell move from the land to the sea and will cause warmer drier conditions – offshore winds
- the other side move from the sea to the land - moist cloudy and rainy conditions forms – onshore winds
- The west coast the air is dry and cool and advection fog often develops rather than rain at the onshore side of the LP.

## Coastal low pressure cells along the east and west coast



Onshore winds cause moist conditions – over cold ocean current advection fog develops.

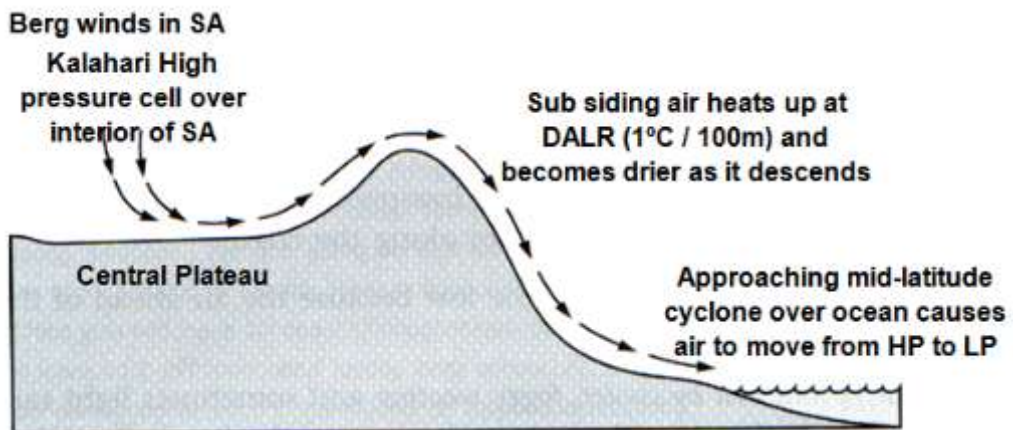
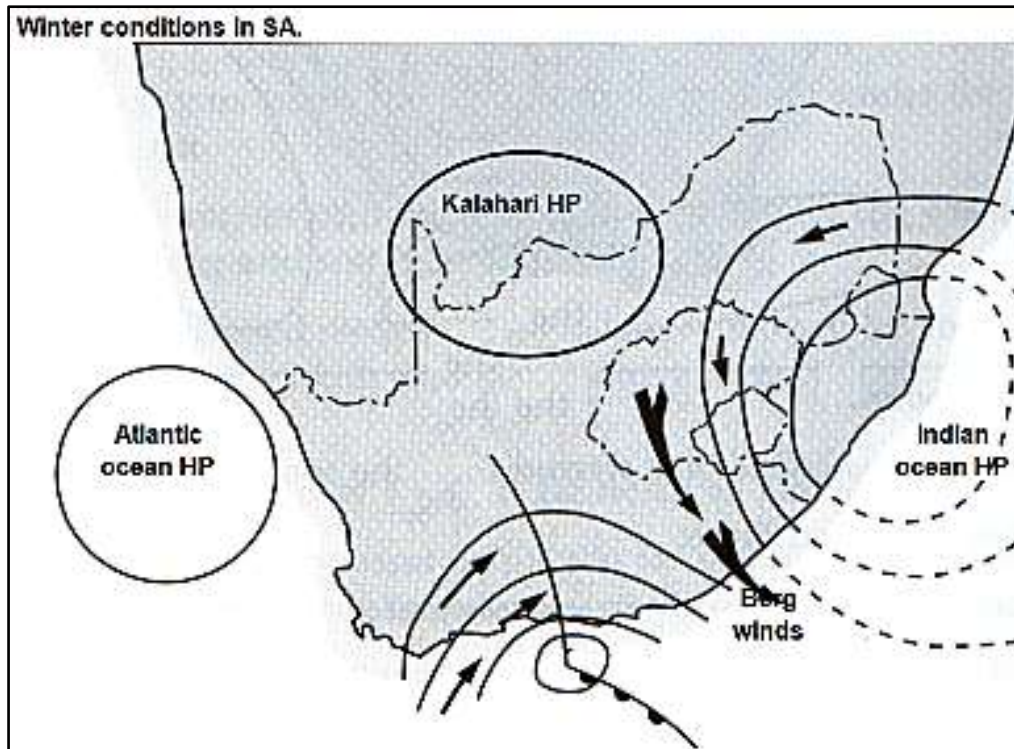
Offshore winds cause dry clear conditions

Offshore winds cause dry clear conditions as air heat up as it sinks.

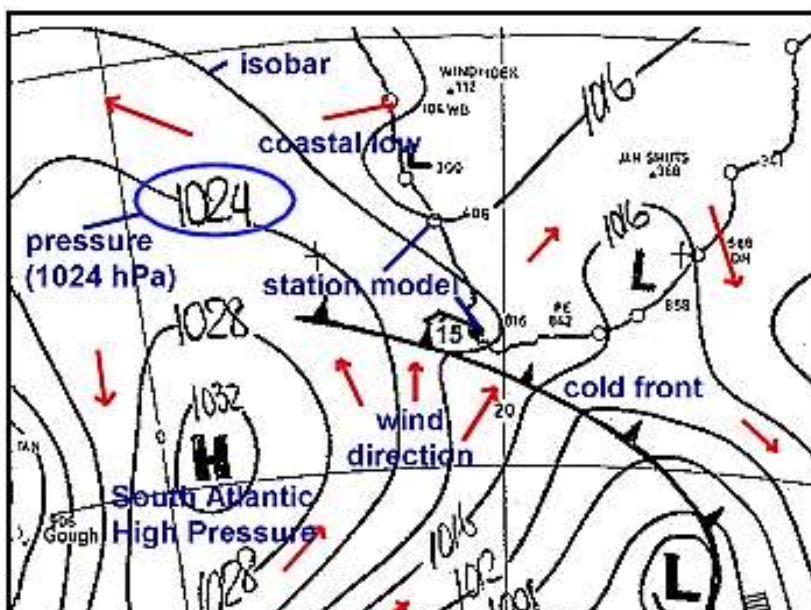
Onshore winds cause cloudy rainy conditions as air is lifted orografically

### 5.3. South African berg wind

- Ahead of the mid latitude cyclone berg wind conditions occur
- Air flow 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. ( $1^{\circ}\text{C}/100\text{m}$ )
- This cause hot dry uncomfortable condition in the Southern and Eastern Cape and the chance of runaway fires
- It dissipate quickly when a cold front passes over the area



6. Resultant weather and impact associated with moving disturbances
7. Identification of moving disturbances on synoptic weather maps and satellite images – see synoptic weather maps in notes
8. Reading and interpretation of synoptic weather maps and satellite images that illustrate weather associated with anti-cyclonic conditions



On the chart we see the following:

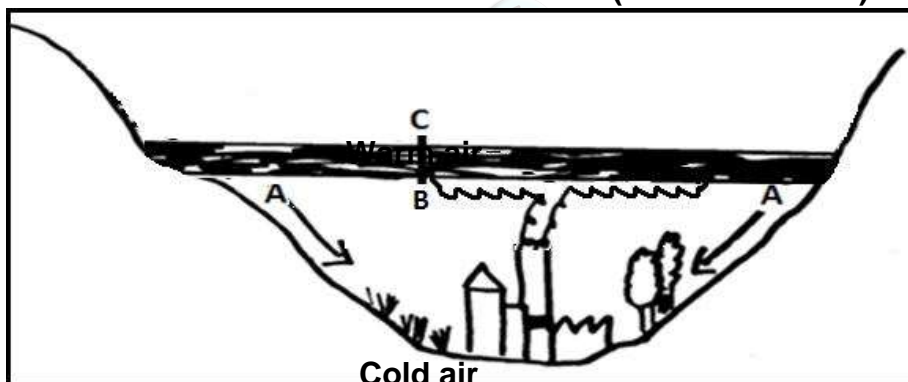
- **isobars**, or lines joining areas of equal pressures, much like contours on a map indicating equal heights
- **pressure values** in hecto Pascal, e.g. 1024 hPa indicated by the upper blue oval on the map above
- **high pressure cells**, i.e. the South Atlantic High Pressure cell is seen SW of Cape Town – pushing the cold front towards SA
- **low pressure cells**, i.e. the low pressure cell at the bottom of the map associated with
- **Mid-latitude Cyclones / cold front** and
- **coastal low** pressure cell along the Namibian coastline – with onshore





- 1.1.1 Name high pressure cell **A**. (1 x 1) (1)
- 1.1.2 In which season do berg winds generally occur? (1 x 1) (1)
- 1.1.3. With reference to the diagram, state TWO conditions under which berg winds originate. (2 x 2) (4)
- 1.1.4. Give ONE reason for the change in the temperature of berg winds as they blow from the interior (**A**) to the coast (**B**). (1 x 2) (2)
- 1.1.5. Refer to the weather station at **C** and give ONE reason for the clear skies. (1 x 2) (2)
- 1.1.6 Why are berg winds associated with veld fires in winter? (2 x 2) (4)

**FIGURE 2: TEMPERATURE INVERSION (November 2014)**

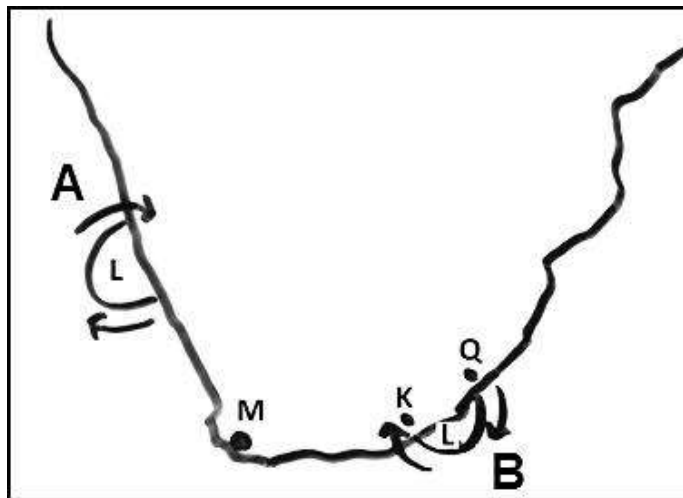


[Source: Examiner's own sketch]

- 2.1. Study the sketch in FIGURE 2 showing a temperature inversion in a valley and answer the questions that follow.
- 2.1.1 Define the term *temperature inversion* indicated by **B** and **C**. (1 x 1) (1)
- 2.1.2 Name the wind at **A**. (1 x 1) (1)

- 2.1.3. Explain why the wind in QUESTION 2.1.2 commonly occurs at night in valleys. (1 x 2) (2)
- 2.1.4. Explain why radiation fog is likely to develop in the valley at night time. (2 x 2) (4)
- 2.1.5. In a paragraph of approximately EIGHT lines, evaluate the likely impact of the wind at **A** on farming and settlements on the valley floor. (4 x 2) (8)

**FIGURE 3: COASTAL LOW-PRESSURE CELLS (November 2014)**



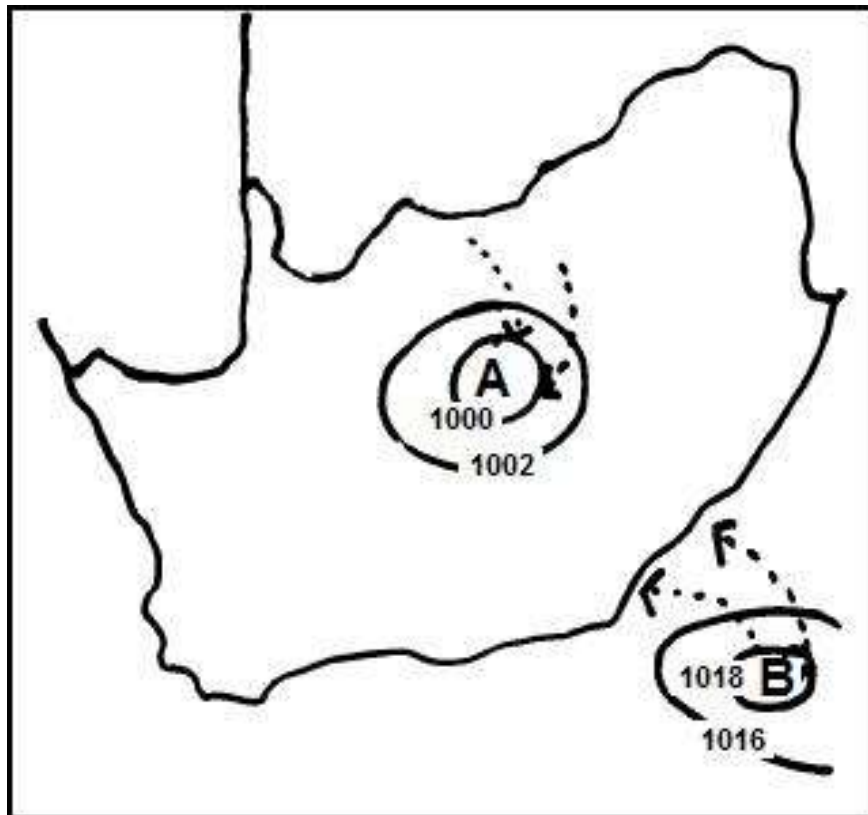
- 3.1. Refer to FIGURE 3. showing two coastal lows, **A** and **B**. Choose ONE term in brackets to make each of the following statements TRUE:
- 3.1.1. Air circulation in pressure cells **A** and **B** is (clockwise/ anticlockwise).
- 3.1.2. Air (converges/diverges) at pressure cells **A** and **B**.
- 3.1.3. Pressure cell **A** will have (lower/higher) moisture content than pressure cell **B**.
- 3.1.4. Pressure cell **A** is associated with (fog/drizzle).
- 3.1.5. The air pressure at **B** will be (lower/higher) than at **A**.
- 3.1.6. Place **M** will soon be affected by weather system (**A/B**).

3.1.7. Place (K/Q) will experience berg winds.

(7 x 1) (7)

(2015 February)

**FIGURE 4: PRESSURE CELLS**



4.1. Study FIGURE 4 which shows two common pressure systems (**A** and **B**) that occur over South Africa. Match each of the statements below to either pressure cell **A** or **B**.

4.1.1. Known as the heat low pressure cell

4.1.2. Also referred to as an anticyclone

4.1.3. Associated with unstable weather conditions

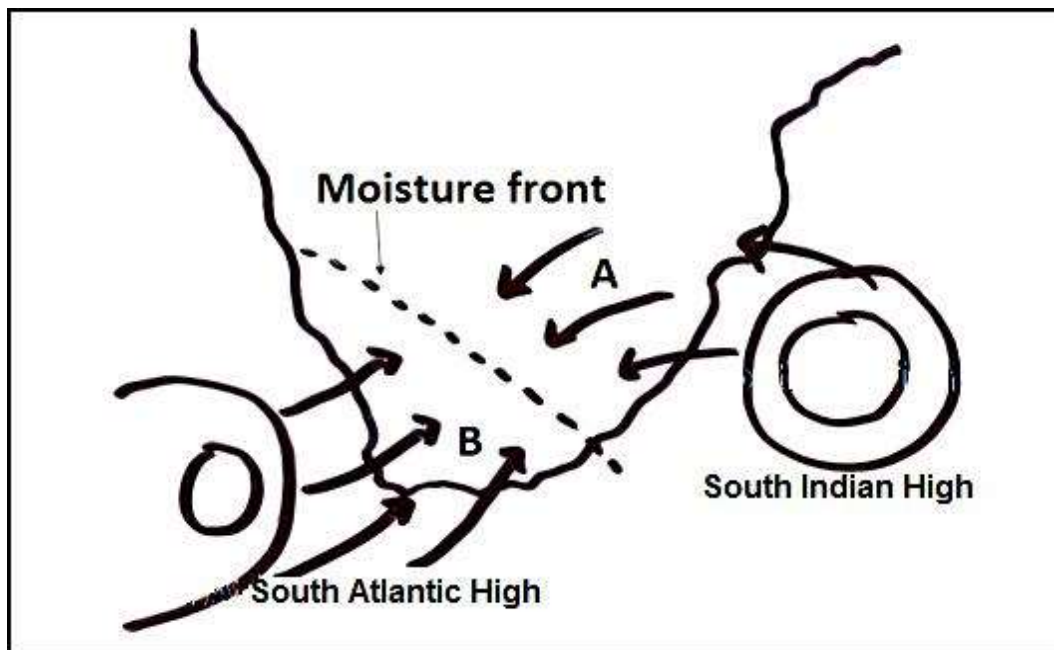
4.1.4. Causes south-easterly winds to blow over the east coast of South Africa

4.1.5. Air diverges from this pressure cell

4.1.6. Dominates the land in summer

4.1.7. Associated with convection thunderstorms (7 x 1) (7)

**FIGURE 5: MOISTURE FRONT (February 2015)**

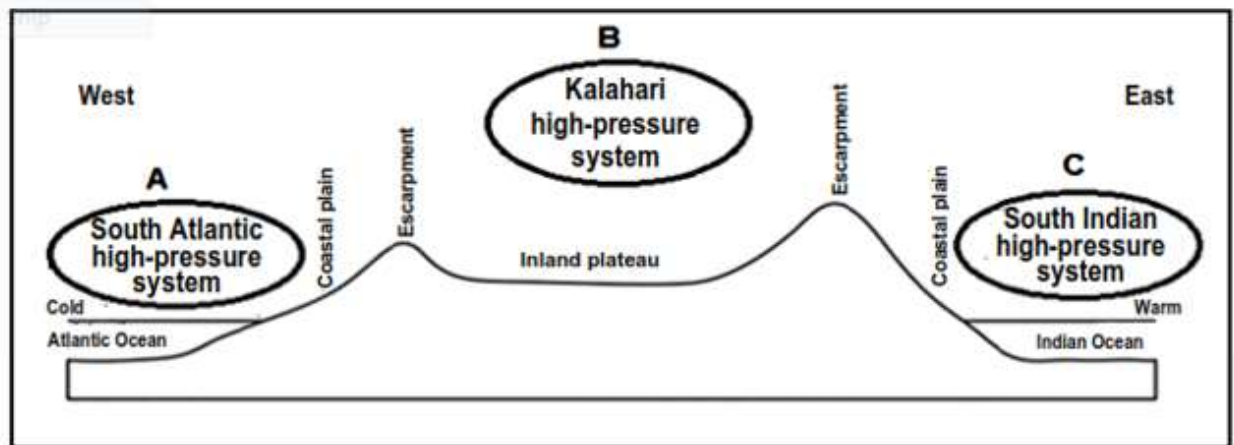


5.1. FIGURE 5. shows a moisture front across South Africa.

- 5.1.1 What is a *moisture front*? (1 x 1) (1)
- 5.1.2 Distinguish between the moisture contents of the winds at **A** and **B**. (2 x 1) (2)
- 5.1.3 Name the type of thunderstorm that occurs along the moisture front. (1 x 2) (2)
- 5.1.4 On which side of the moisture front do the thunderstorms form? (1 x 2) (2)
- 5.1.5 Explain your answer to QUESTION 2.4.4. (2 x 2) (4)
- 5.1.6 Describe the hazards/dangers associated with these thunderstorms for farmers in the interior. (2 x 2) (4)

(2015 November)

FIGURE 6



[Adapted from [cnx.org](http://cnx.org)]

6.1 Refer to FIGURE 6, which shows the position of anticyclones over South Africa. Indicate whether each of the statements below refers to anticyclone **A**, **B** or **C**. Write only the letter (**A**, **B** or **C**) next to the question number (6.1.1–6.1.7) in the ANSWER BOOK.

6.1.1. The subsiding air causes semi-arid conditions on the West Coast of South Africa.

6.1.2. In summer this pressure cell is found at a higher altitude due to surface heating.

6.1.3. The subsiding air forms an inversion layer in winter that prevents moist air from reaching the interior.

6.1.4. The ridging of this pressure cell results in rainfall over the South-western Cape.

6.1.5. Interaction with a coastal low results in berg wind conditions.

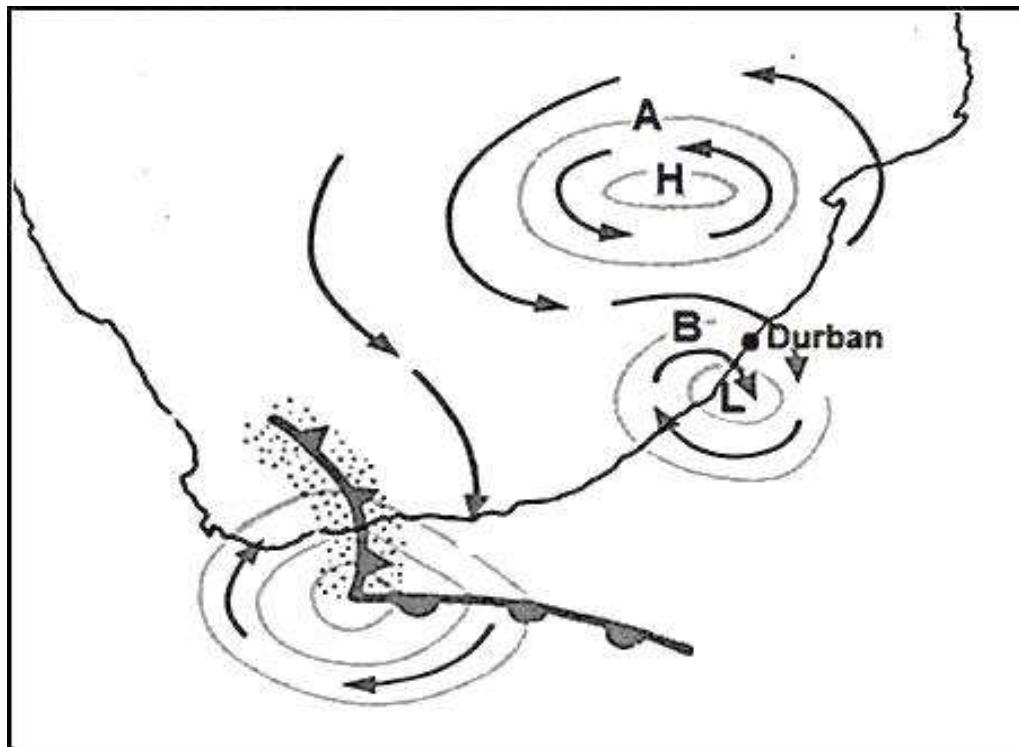
6.1.6. Sometimes this pressure cell is known as a blocking high when it is in the path of a mid-latitude cyclone.

6.1.7. This pressure cell is generally associated with fog and reduced visibility.

(7 x 1) (7)

**FIGURE 7: BERG WIND CONDITIONS (November 2015)**

FIGURE 7



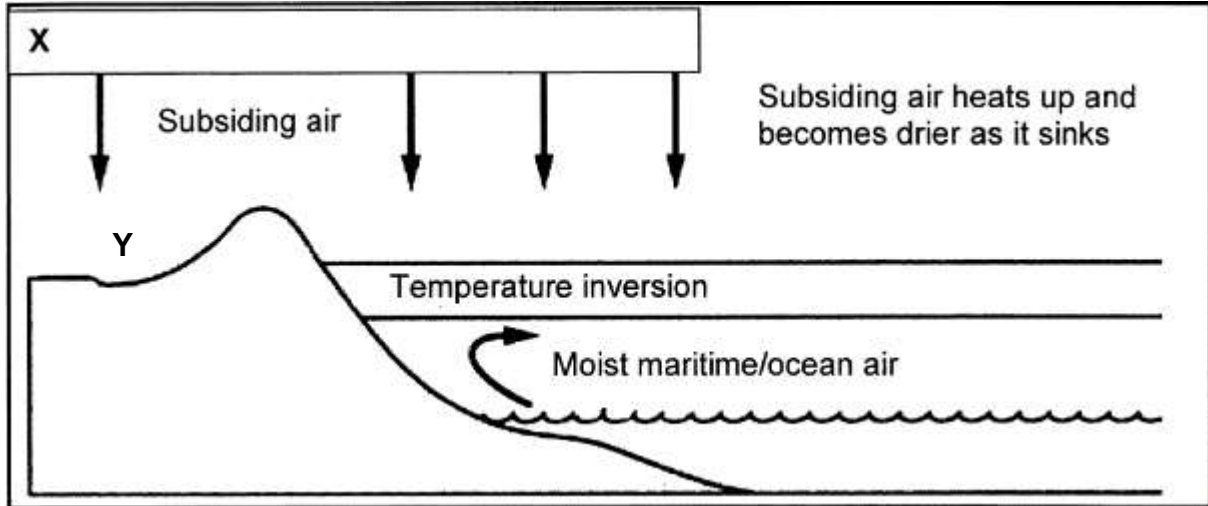
7. Refer to FIGURE 7, showing berg wind conditions. Choose the correct word(s) from those given in brackets. Write only the word(s) next to the question number (2.1.1–2.1.8) in the ANSWER BOOK.

- 7.1.1. Berg wind conditions occur during (summer/winter).
- 7.1.2. Pressure cell **A** is the (Kalahari/South Atlantic) high-pressure cell.
- 7.1.3. Pressure cell **B** is a (thermal/coastal) low-pressure cell.
- 7.1.4. The general direction of movement of the frontal depression is (eastwards/westwards).
- 7.1.5. Durban will experience (onshore/offshore) winds.
- 7.1.6. The cloud cover at Durban will be (overcast/clear) due to the winds identified in QUESTION 2.1.5.
- 7.1.7. (Onshore/Offshore) winds are associated with fog and light rain.
- 7.1.8. The risk of veld fires during berg wind conditions (increases/decreases) in the eastern parts of South Africa. (8 x 1) (8)

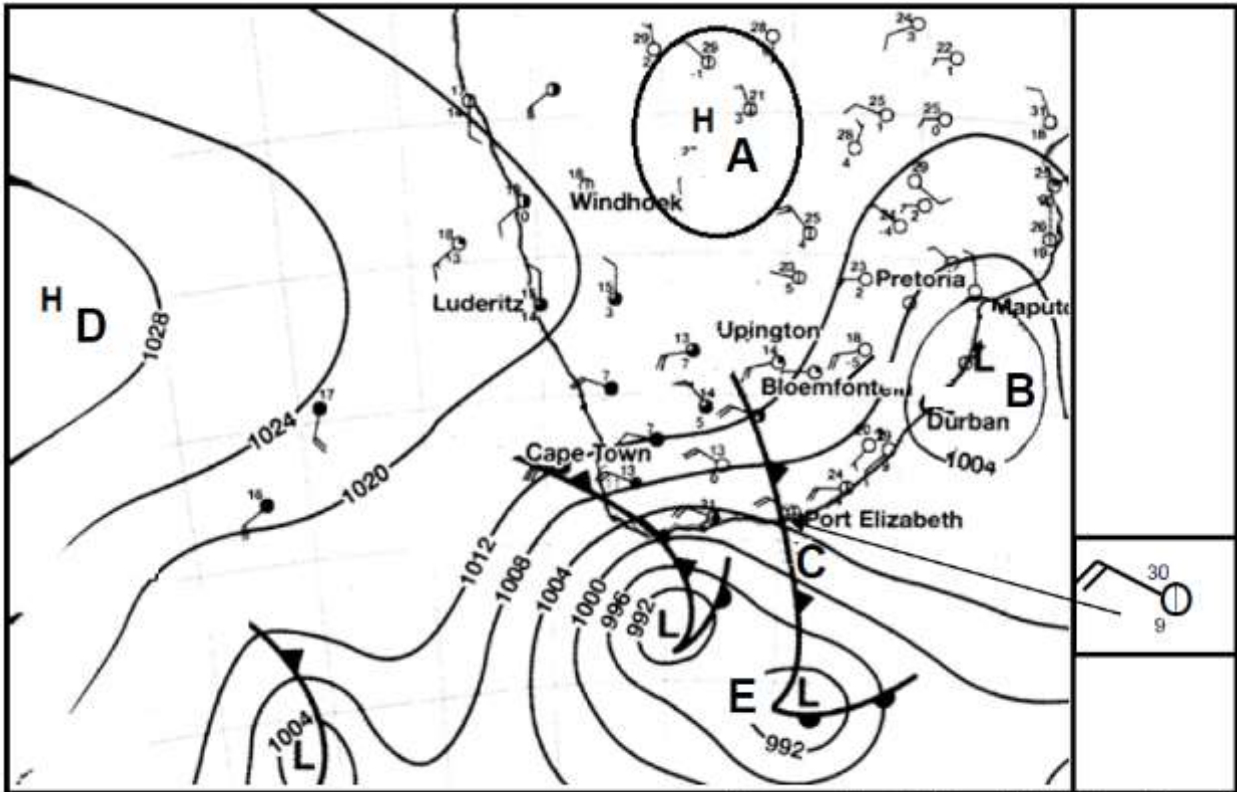
**SECTION C: HOMEWORK QUESTIONS ON ANTI-CYCLONES IN SA**

**QUESTION 1: 30 minutes [32] (Adapted from NSC Trial 2013 Paper 1)**

Determine if this sketch illustrates summer or winter in South Africa.



1. Study the figure above which illustrates an anti-cyclone over the Southern African interior and answer the questions that follow.
  - 1.1. Give three characteristics of the air movement associated with high pressure systems of the interior of South Africa. (3 x 1) (3)
  - 1.2. Identify the high pressure system labelled X. (1 x 1) (1)
  - 1.3. Give a definition for temperature inversion. (1 x 2) (2)
  - 1.4. State the relationship between vertical air movement and temperature. (2 x 2) (4)
  - 1.5. State the relationship between temperature and relative humidity of an air mass. (2 x 2) (4)
  - 1.6. a) Does this sketch illustrate winter or summer conditions? (1 x 1) (1)  
 b) Give two reasons for your answer in 1.4. b. (2 x 2) (4)
  - 1.7. a. What type of precipitation may occur at Y during the night? (1 x 1) (1)  
 b. Explain why this type of precipitation forms over the central interior in this season. (2 x 2) (4)
  - 1.8. High pressure system marked X results in different weather conditions over the South African interior during summer and winter months respectively. In a paragraph mention and explain the different weather condition that will be experienced in South Africa in summer and winter respectively. (4 x 2) (8)



[Source: Adapted from SA Weather Bureau]

2. Study the synoptic weather map/chart above and answer the questions that follow.
  - 2.1. Name the type of low-pressure cell at B. (1 x 1) (1)
  - 2.2. Describe how and explain why the weather conditions at Maputo and Durban will differ due to this low pressure cell. (4 x 2) (8)
  - 2.3. Identify the pressure cells labelled A and D respectively. (2 x 2) (4)
  - 2.4. State the pressure at the centre of the cells D and E respectively. (2 x 2) (4)
  - 2.5. Identify TWO pieces of evidence from the synoptic map/chart to indicate that it represents winter conditions. (1 x 2) (2)
  - 2.6. Identify the weather system labelled E. (1 x 2) (2)
  - 2.7. Describe the weather at Port Elizabeth by referring to the enlarged weather station. (5 x 1) (5)
  - 2.8. State THREE weather changes that Port Elizabeth could possibly experience in the next few hours. (2 x 2) (4)
  - 2.9. Write a paragraph (approximately 12 lines) explaining why Port Elizabeth is experiencing unusually high temperatures and what impact the weather conditions will have on the environment. (4 x 2) (8)



**SESSION 4 – TOPIC4:**

**SECTION A: NOTES ON CONTENT ON MICRO / LOCAL CLIMATE**

**TERMINOLOGY / DEFINITIONS**

**Anabatic winds:** winds blowing up valley sloped during the day

**Katabatic winds:** winds blowing down valley slopes during the night

**Inversions/thermal belt:** a layer of warm air above cold air in a valley during the night

**Frost pockets:** cold air at the bottom of a valley during the night where frost forms

**Radiation fog:** fog that forms in valleys when a layer of air cools down due to fast radiation at night.

**Urban heat island:** warm air over a city – warmer than surrounding rural areas

**Pollution dome:** the hot polluted air concentrated over cities.

**Radiation:**

**Advection:**

**Frost:**

**Dew point temperature:**

**Smog:**

**Visibility:**

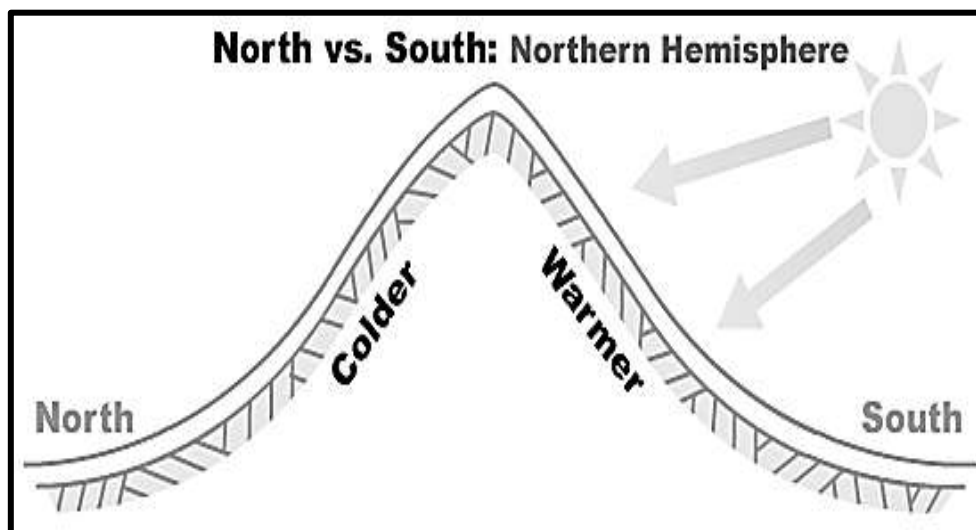
**STUDY TIPS:** This work is easy to understand and get marks for in exams. Know the definitions and sketches well.

**1. VALLEY CLIMATES**

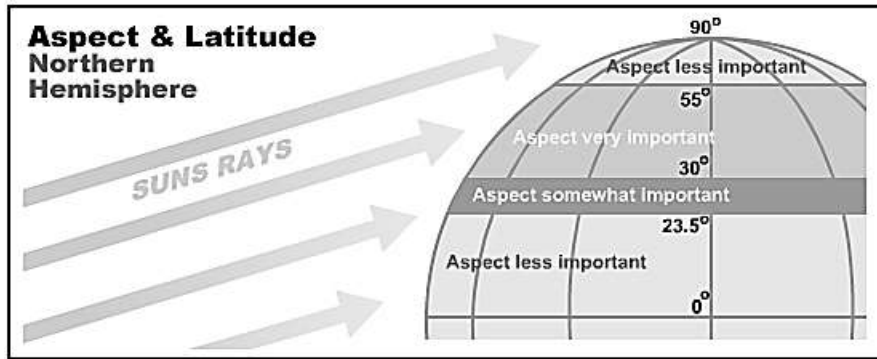


**1.1. Slope aspect**

Definition: Aspect refers to the direction in which a slope in a valley faces which determines how much sunlight it receives



<http://www.fsavalanche.org/encyclopedia/aspect.htm>



## 1.2. Impact on the distribution of temperature in a valley

- Slopes that are parallel to the Equator experience large differences between temperatures
- Equator facing slopes will be warmer (Southern slopes in the northern hemisphere and northern slopes in the southern hemisphere)
- Pole facing slopes are colder as it receives less sunlight

## 1.3. Impact on human activities in a valley

- Slopes facing the Equator in both hemispheres are warmer, which lead to more evaporation of ground water and drier soil – people settle here and plant crops that need sunlight, heat and well drained soils
- Slopes facing the poles are much colder, which cause less evaporation and moist soil conditions – Plantations are often planted here as trees grow well in the shady, cool moist conditions.

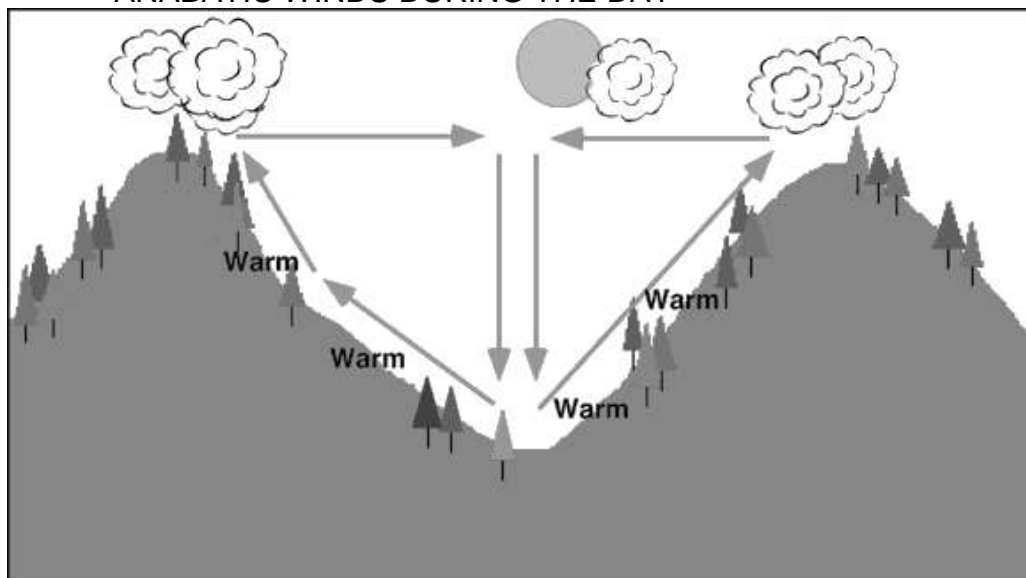
## 1.4. Development of valley winds

- 1.4.1. Anabatic winds – upslope during the day due to rising air masses on hills that are heated first in the morning
- 1.4.2. Katabatic winds – down slope at night – cold air in contact with cold land surface sinks to valley floor as it is heavy
- 1.4.3. Inversions/thermal belt – layer of warm air above cold frost pocket which is pushed up by the sinking cold air - night
- 1.4.4. Frost pockets – pool of cold air on the valley floor at night - reaches dew point under 0°C and frost forms
- 1.4.5. Radiation fog –develops at night in a valley when radiation causes heat to be lost quickly and the air mass reach dew point temperature

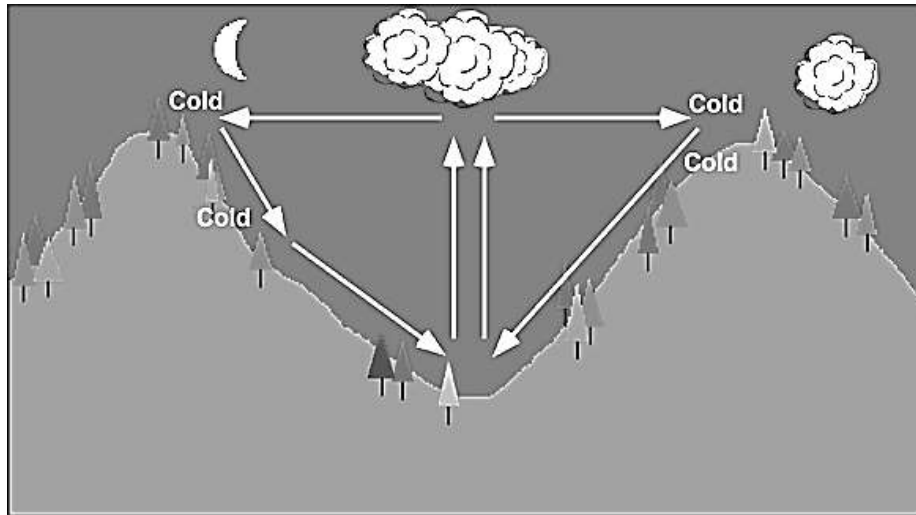
Day conditions in a valley	Night conditions in a valley
<ul style="list-style-type: none"> <li>- Hills heat up first as sun shine on them first</li> <li>- Air above hills heat up and rises causing LP to develop on hills</li> <li>- Cold air in valley forms HP</li> <li>- Winds blow from the HP on the valley floor to the LP on the hills</li> <li>- These winds are called Anabatic winds</li> <li>- The whole wind system that develop in the valley are called Valley winds</li> </ul>	<ul style="list-style-type: none"> <li>- On cloudless nights the terrestrial radiation takes place fast and the valley cools down quickly</li> <li>- On windless nights the air in a valley does not mix and form layers with different temperatures</li> <li>- The air in contact with the cold land surface cools down more than the rest of the air</li> <li>- This cold air becomes dense and heavy and drains to the bottom of the valley</li> <li>- These are Katabatic winds</li> <li>- The cold air displaces the warmer air upwards</li> <li>- The layer of warm air above the cold air forms a temperature inversion (negative temperature lapse rate)</li> <li>- Frost forms on the cold valley floor on winters nights</li> <li>- If the cold winds reach dew point temperature, radiation fog will develop in the valley at night</li> </ul>

**1.5. Draw simple freehand sketches to show anabatic and katabatic winds**

**ANABATIC WINDS DURING THE DAY**



## KATABATIC WINDS AT NIGHT



### 1.6. The Influence of Valleys climates on human activities

#### 1.6.1. Settlement

- People settle on equator facing slopes as it is warmer in the day in cool areas, but in warm areas the cool pole facing slopes are popular
- People settle in the thermal belt above the frost pocket as it is warmer at night

#### 1.6.2. Farming

- Stock pens are built above the frost pocket in the thermal belt to avoid stock losses
- The lower part of the valley is used for grazing
- Frost resistant crops are planted on the valley floor
- Frost sensitive plants are planted in the thermal belt
- Crops that need well drained soils with a lot of suns are planted in the equator facing slopes.

## 2. Urban Climates

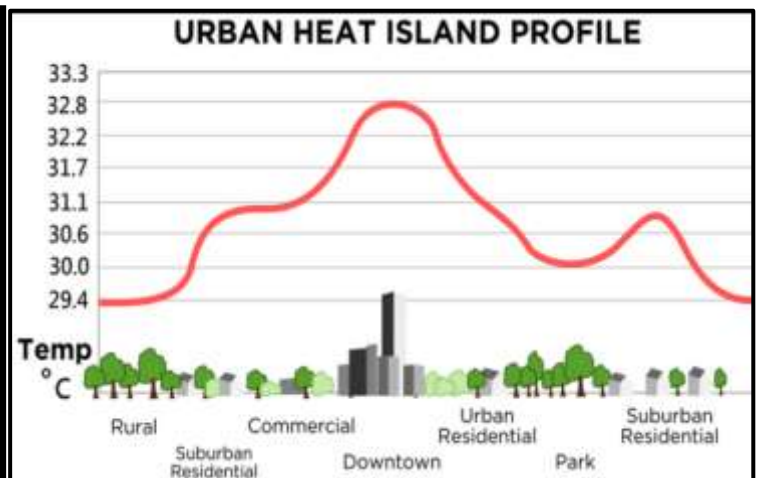
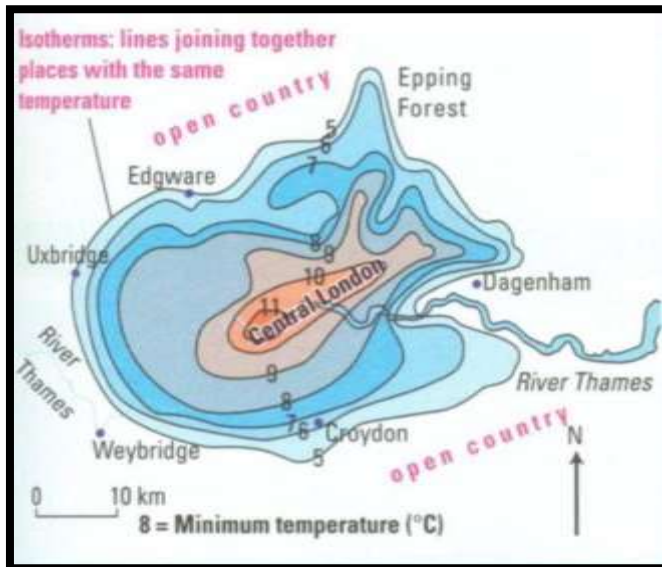
Cities are warmer, has drier air, but more precipitation, more gusty winds

### 2.1. Reasons for differences between rural and urban climates

Difference	Reason for difference
Cities are warmer	Artificial surfaces and heat sources generate extra heat and pollutants trapping heat Less evaporation which is a natural cooling process Less vegetation which can absorb heat
The air in cities are drier	All water is drained immediately after rain in storm water drains – very little evaporation in cities
There is more precipitation	Warmer air is unstable and rises easily to form clouds Large amount of pollutants forms condensation nuclei which cause condensation to take place sooner
The wind is slower but more gusty	The tall buildings slow winds but channel winds along streets and corners of buildings – stronger and gusty winds

## 2.2. Urban heat islands

The urban heat island is a pool of warm polluted air over a city which is warmer than the surrounding rural air.



### 2.2.1. CAUSES OF URBAN HEAT ISLANDS

#### / FACTORS CONTRIBUTING TO HIGHER CITY TEMPERATURES

- Artificial surface 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 dirt air

### 2.2.2. EFFECTS OF URBAN HEAT ISLANDS

- Pollution domes – pool of polluted air over a city. During the night the pollution dome is smaller and more concentrated due to cooler conditions. During the day the pollution dome is larger and the pollution is less concentrated as the warmer day conditions lead to convection.
  - Causes of pollution domes
    - Power stations
    - Vehicle emissions
    - Open fires for cooking and heating in squatter camps
  - Effects of pollution domes
    - Respiratory illnesses e.g. asthma
    - Memory loss
    - Acid rain – corrosion of buildings



- Strategies to reduce the urban heat island effect
  - Restrictions on factory emissions
  - Greenbelts in cities where natural vegetation is conserved or parks are developed – to absorb CO<sup>2</sup> emissions
  - Improved public transport to reduce the number of vehicles on the road
  - Hybrid and electric cars

### 3. Interpretation of Synoptic Weather Maps – Learners must be able to

- Use international weather symbols
- Identification and characteristics of high- and low-pressure cells
- Interpretation of the impact of high- and low-pressure cells
- Reading and interpretation of station models
- Satellite images - reading and interpretation

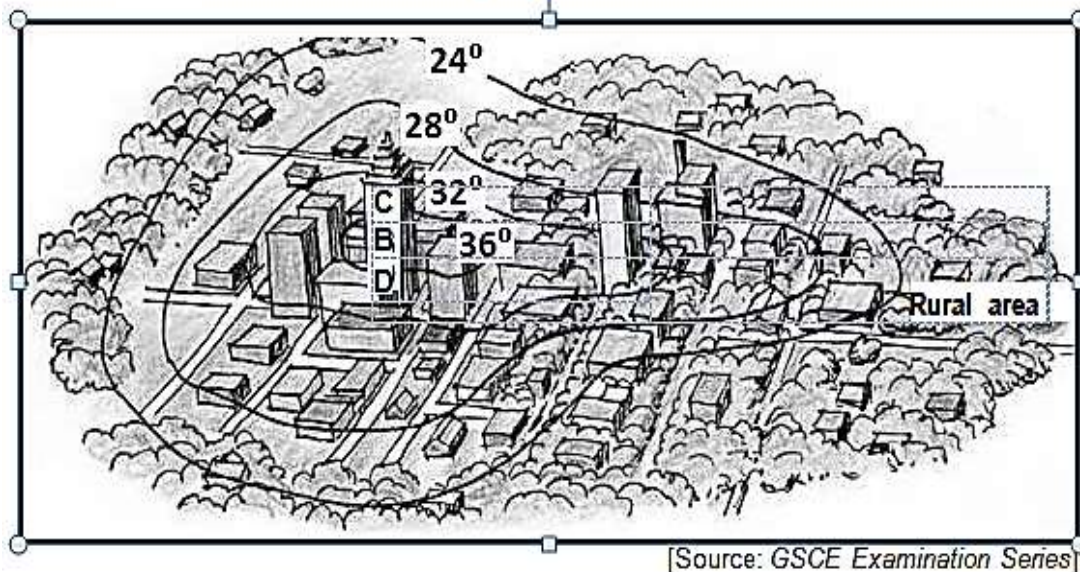
Compare satellite images to synoptic weather maps (see activities)



**SECTION B: TYPICAL EXAM QUESTIONS ON MICRO / LOCAL CLIMATE**

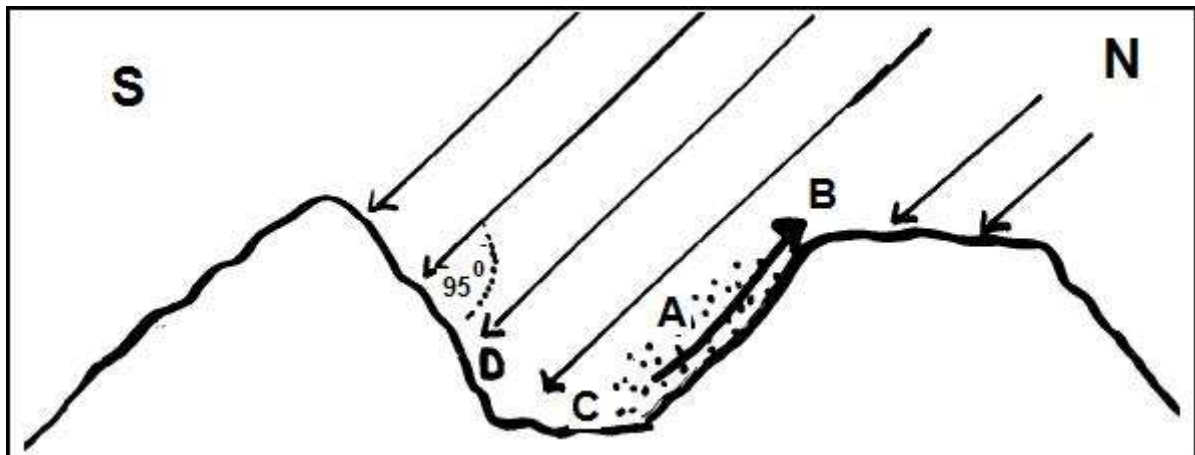
Valley and City climate 2014 November

**FIGUR 1 URBAN HEAT ISLAND**



1.1. Study FIGURE 1 which shows a heat island over a South African city.

- 1.1.1. What is the name given to the lines that show the temperature readings over the city? (1 x 1) (1)
- 1.1.2. What is the temperature difference between the CBD and the rural area? (1 x 2) (2)
- 1.1.3. How do high-rise buildings contribute to the CBD having a higher temperature? (1 x 2) (2)
- 1.1.4. Suggest TWO possible reasons why the temperature lines mentioned in QUESTION 2.4.1 are not circular. (2 x 2) (4)
- 1.1.5. Each statement below describes a typical urban microclimate. Give a reason why each of these conditions are experienced in an urban area.
  - (a) Relative humidity is lower above the city than above the surrounding rural area. (1 x 2) (2)
  - (b) The city has more days on which precipitation occurs than the surrounding rural area. (1 x 2) (2)
  - (c) Wind speed in the CBD is stronger than in the surrounding countryside. (1 x 2) (2)

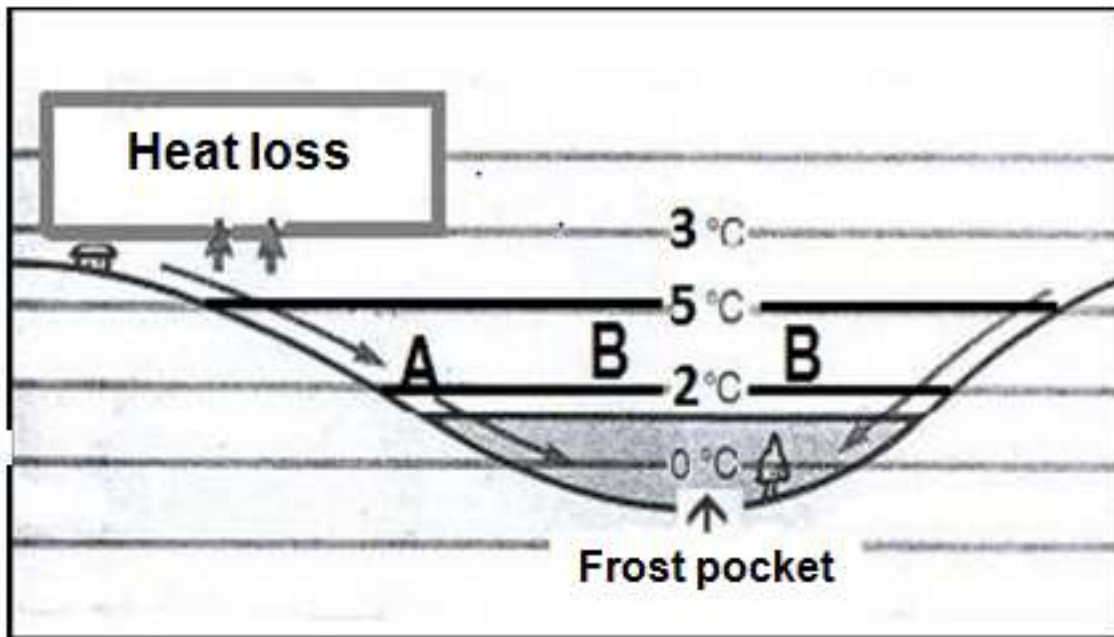


- 2.1. Refer to the sketch in FIGURE 2 which shows aspect in a valley in the Southern Hemisphere and answer the questions that follow.
- 2.1.1. Define the term aspect. (1 x 1) (1)
- 2.1.2 What evidence suggests that this valley is situated in the Southern Hemisphere? (1 x 1) (1)
- 2.1.3 Explain why area A is referred to as the shadow zone. (1 x 2) (2)
- 2.1.4 Explain how wind B will develop during the day. (2 x 2) (4)
- 2.1.5 In a paragraph of approximately EIGHT lines, give advice to a farmer on how to plan the usage of the land at place C and place D effectively, taking into account the influence of aspect and resultant winds. (4 x 2) (8)



2015 June

**FIGURE 3 VALLEY CLIMATES**



[Source: <http://www.educom/climates>]


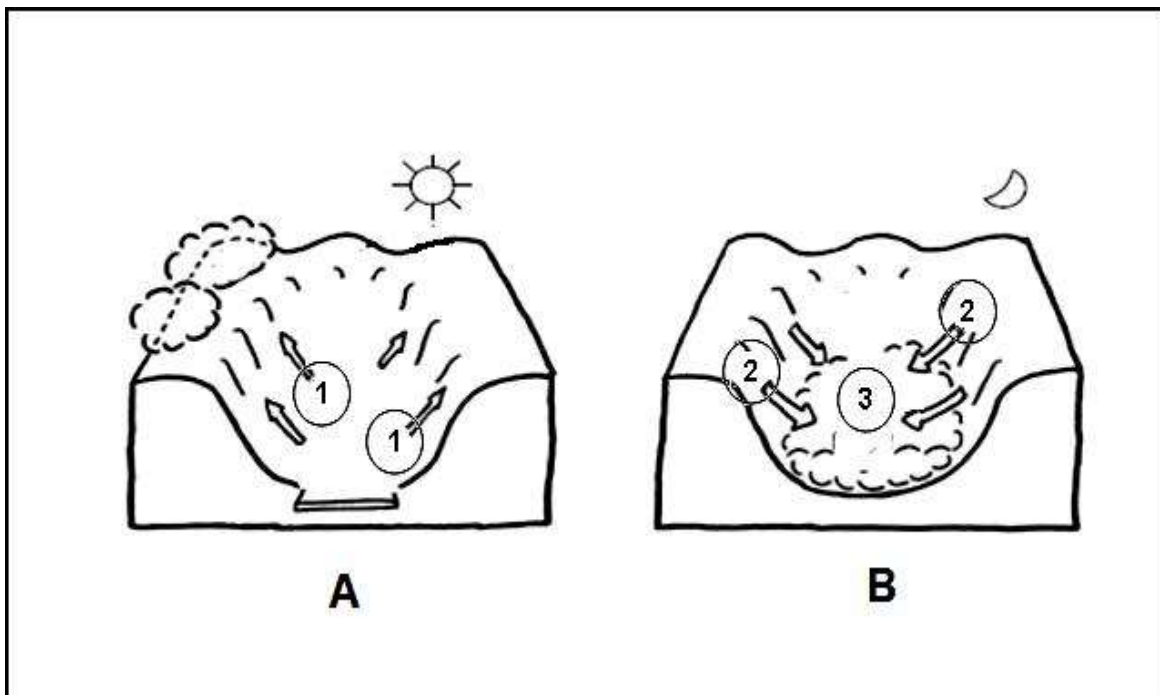
- 3.1. FIGURE 3 illustrates valley climates. 
- 3.1.1 Identify wind A. (1 x 1) (1)
- 3.1.2 Explain why this wind occurs at night. (2 x 2) (4)
- 3.1.3 Give ONE reason why the layer of warm air at B is situated halfway up the slope. (1 x 2) (2)
- 3.1.4 In a paragraph of approximately EIGHT lines, explain the impact of the layer of warm air at B on human activities in the valley. (4 x 2) (8)

FIGURE 4: VALLEY CLIMATES



4.1. Study FIGURE 4 on valley climates and answer the questions that follow.

4.1.1 Name wind 1 in sketch A. (1 x 1) (1)

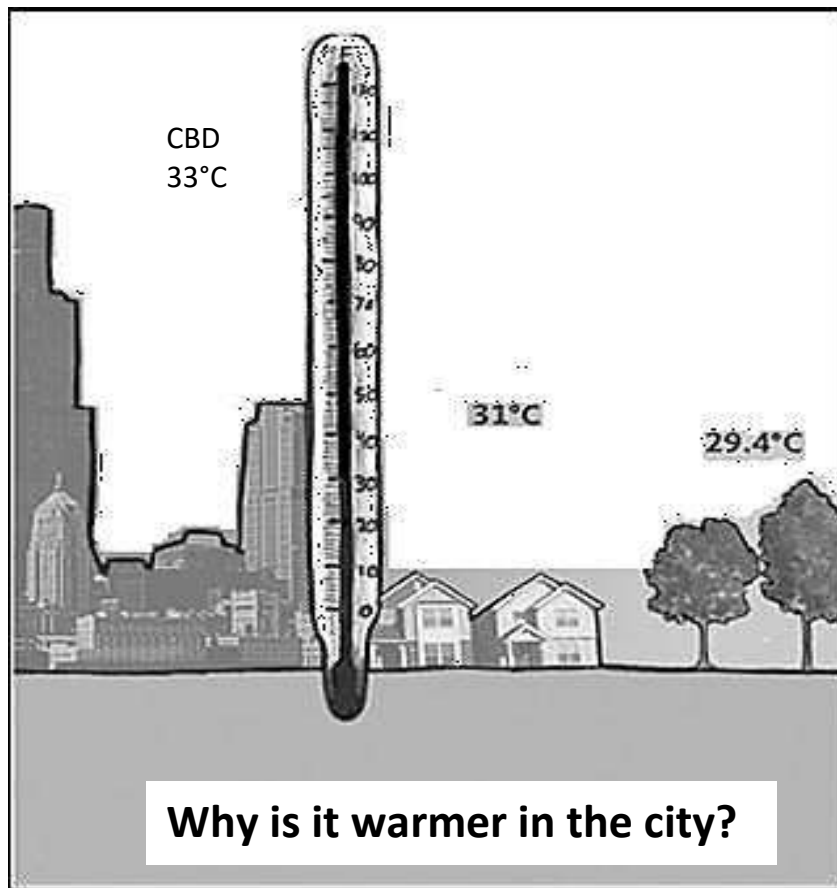
4.1.2 State ONE difference between winds 1 and 2. (1 x 2) (2)

4.1.3 Would wind 1 or wind 2 originate if a higher pressure occurred at the top of the valley slope? Give a reason for your answer. (2 x 2) (4)

4.1.4 Explain why visibility on the valley floor (3) is less on winter mornings. Draw a labelled diagram to support your answer. (4 x 2) (8)

2015 November

FIGURE 5: CITY CLIMATE

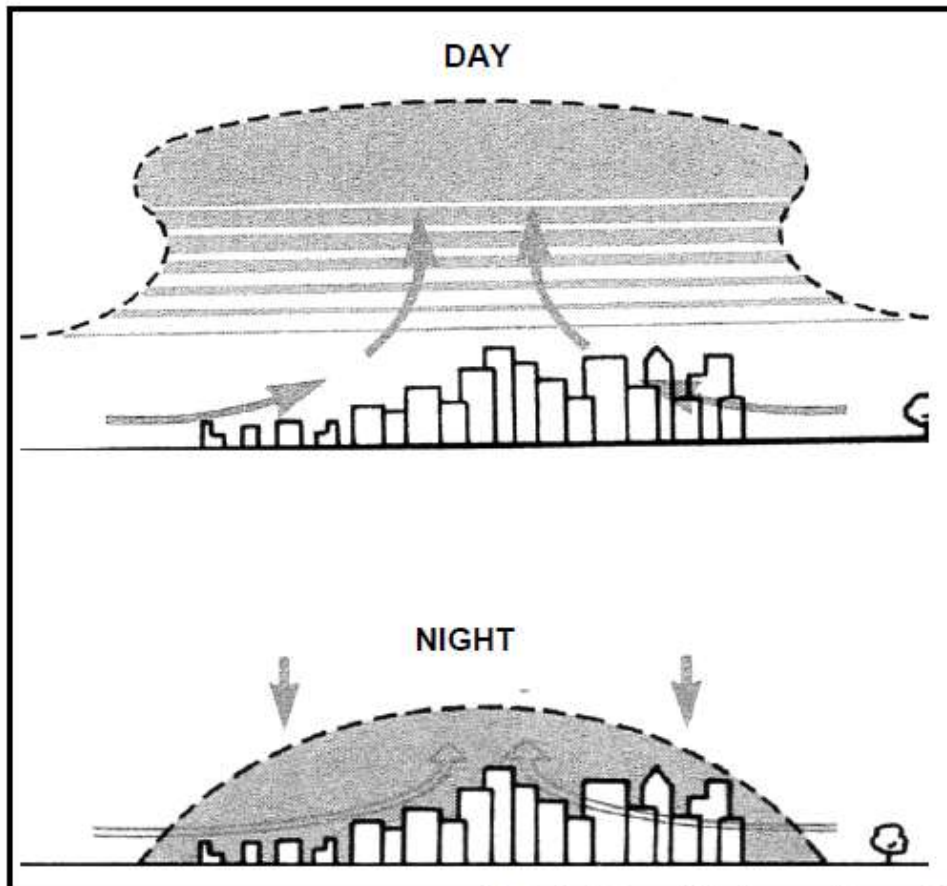


- 5.1. Refer to FIGURE 5 showing the difference in temperature between the CBD and the surrounding rural area of a South African city, and answer the questions that follow.
- 5.1.1. Calculate the difference in temperature between the CBD and the rural area. (1 x 1) (1)
- 5.1.2 Give a term that describes this difference in temperature between the CBD and the rural area. (1 x 1) (1)
- 5.1.3 Discuss how building density contributes to the CBD having higher temperatures. (2 x 2) (4)
- 5.1.4 Draw a labelled diagram showing the structure of the urban heat island during the day for FIGURE 2.4. (2 x 2) (4)
- 5.1.5 Give TWO sustainable solutions to reduce the temperature in the CBD. (2 x 2) (4)

**SECTION C: HOMEWORK QUESTIONS ON MICRO / LOCAL CLIMATE**

**QUESTION 1: 15 minutes [22] (Adapted from NSC March 2013 Paper 1)**

**FIGURE HEAT ISLAND**



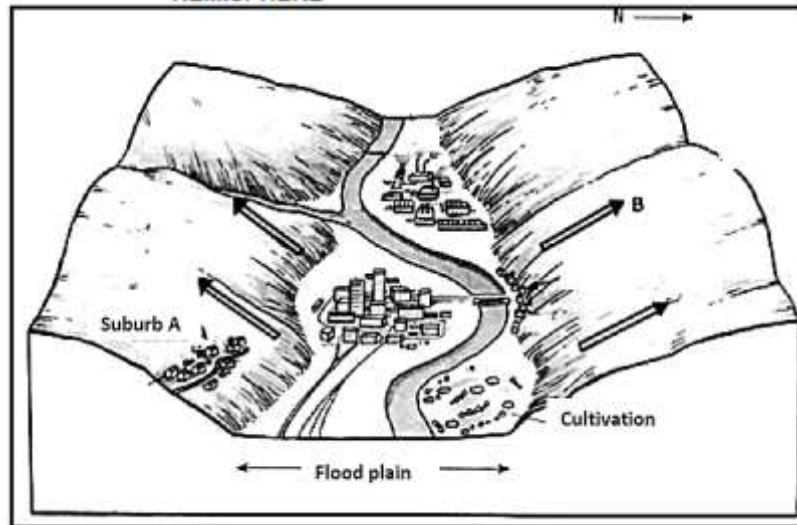
[Adapted from *Window on the world*]

1. Study the sketches in the figure above which show the daily changes in the intensity of an urban heat island.
  - 1.1. What is an urban heat island? (1 x 2) (2)
  - 1.2. State TWO factors that cause urban heat islands. (2 x 2) (4)
  - 1.3. Differentiate between the shape of the heat island during the day and the shape of the heat island at night. (2 x 2) (4)
  - 1.4. Explain why urban areas have more clouds than rural areas. (2 x 2) (4)
  - 1.5. Write a paragraph (approximately 12 lines) to discuss the impact of heat islands on people. (4 x 2) (8)

**QUESTION 2: 10 minutes**

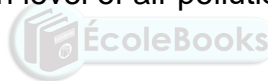
*(Adapted from NSC March 2013 Paper 1)*

**FIGURE SETTLEMENT IN A RIVER VALLEY IN THE SOUTHERN HEMISPHERE**



[Adapted from: *Understanding Geography*]

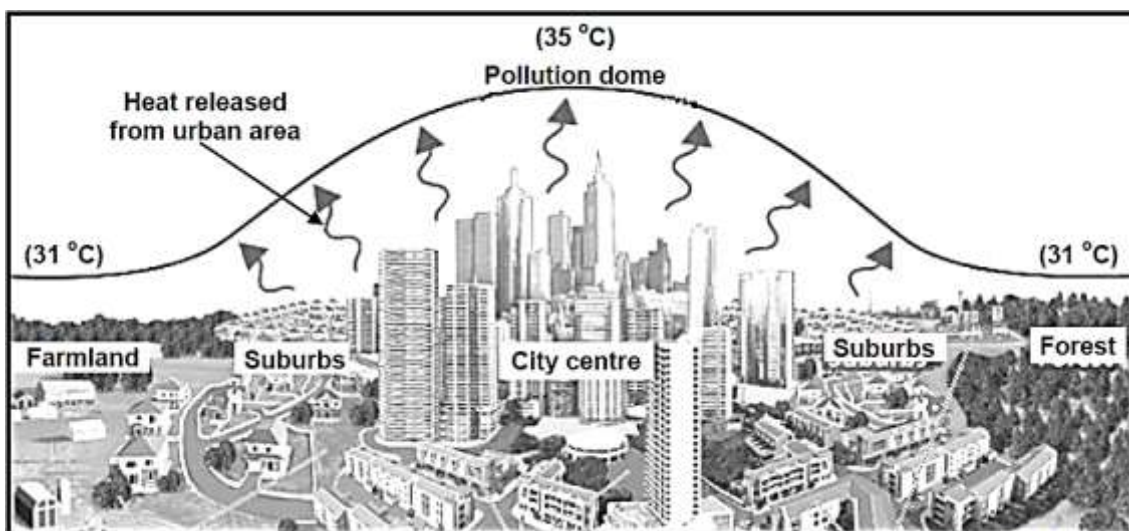
2. Study the figure above that shows a settlement built in a river valley.
  - 2.1. Explain the term *microclimate*. (1 x 2) (2)
  - 2.2. State ONE human activity that would have altered the microclimate of the valley. (1 x 2) (2)
  - 2.3. Give a reason why the suburb labelled **A** was built along the north-facing slope. (1 x 2) (2)
  - 2.4. Name and explain the origin of the wind labelled **B**. (2 x 2) (4)
  - 2.5. Why would there be a high level of air pollution in the valley on a winter's morning? (2 x 2) (4)



**QUESTION 3: 15 minutes**

*(Adapted from NSC Nov 2013 Paper 1)*

3. Study the figure above based on city climate.

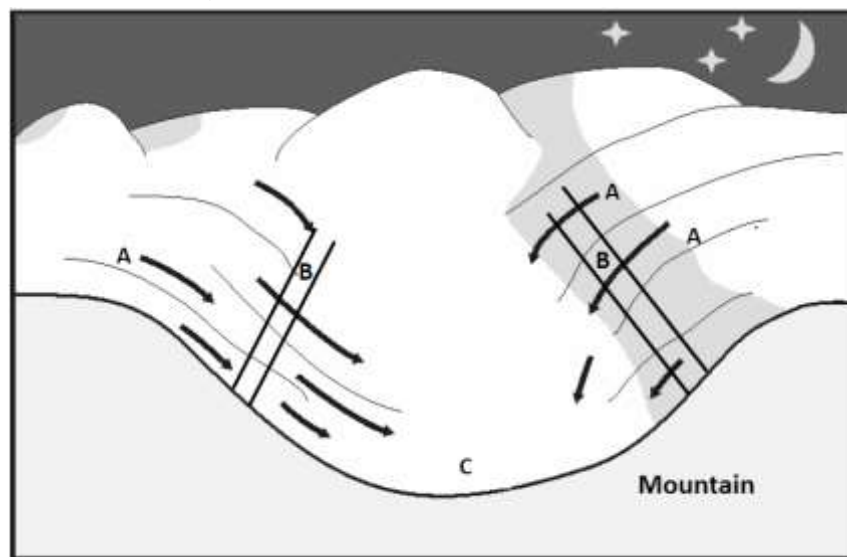


[Source: Adapted from Google Image]

- 3.1. Calculate the difference in temperature between the city centre and the farmland. (1 x 2) (2)
- 3.2. Give TWO reasons from the diagram why this temperature difference occurs. (2 x 2) (4)
- 3.3. Give the term used to describe the warm air over the city centre. (1 x 2) (2)
- 3.4. Explain why the shape of the pollution dome is not the same during the day and night. (2 x 2) (4)
- 3.5. Refer to the pollution dome over the city and give evidence to support the statement that this is a daytime situation. (1 x 2) (2)
- 3.6. Write a paragraph and explain how the conditions illustrated here can be reduced. (4 x 2) (8)

**QUESTION 4: 10 minutes [15] (Adapted from NSC Nov 2011 Paper 1)**

4. Refer to the figure below which shows air movement in a valley. Choose the correct word(s) from those given in brackets. Write only the word(s) next to the question number (2.1. – 2.5.) in the ANSWER BOOK.
  - 4.1.1 The valley wind labelled A is a/an (katabatic/anabatic) wind. (1)
  - 4.1.2 This wind occurs during the (day/night) in valleys. (1)
  - 4.1.3 It is also referred to as a/an (upslope/downslope) wind. (1)
  - 4.1.4 The zone labelled B is the (thermal belt/frost pocket). (1)
  - 4.1.5 The form of precipitation experienced at C is (frost/snow). (1)
  - 4.1.6 These conditions only occur when it is (cloudy / clear). (1)
  - 4.1.7. People prefer to settle on the (valley floor / slopes). (1)
  - 4.1.8. (Frost / Dew) will occur at night when the dew point temperature drops to below 0°C. (1)
  - 4.1.9. (Radiation / Advection) fog in the valley can lead to the formation of smog and poor visibility. (1)
- 4.2. Draw a simple labelled sketch to illustrate the opposite conditions than the ones illustrated in this figure. (6 x 1) (6)



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