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SUBJECT: GEOGRAPHY PAPER 1

GRADE 12

MATERIAL

TERM 1

CLIMATOLOGY

GEOMORPHOLOGY

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<u>TOPIC 1:</u> ❖ MID LATITUDE CYCLONE ❖ TROPICAL CYCLONE ❖ SUBTROPICAL ANTICYCLONE (HIGH PRESSURE CELLS) ❖ VALLEY CLIMATES ❖ URBAN/CITY CLIMATES	
<u>TOPIC 2:</u> ❖ DRAINAGE SYSTEMES IN SOUTH AFRICA ❖ FLUVIAL PROCESSES ❖ CATCHMENT AND RIVER MANAGEMENT	

CYCLONES (LOW PRESSURE SYSTEMS):

❖ MID - LATITUDE CYCLONE

❖ TROPICAL CYCLONE

GENERAL CHARACTERISTICS (SIMILARITIES):

The following characteristics appear in both the mid latitude cyclone and tropical cyclone, hence why we say they are the similarities between the two cyclones.

- Clockwise rotation in the Southern Hemisphere.
- Low pressure cells.
- Circular isobars in the center.
- Pressure readings decrease towards the centre of the cell.
- Occurs all year round.
- The pressure reading of the centre isobar in the mature stage has to be below 1000 hpa.

MID - LATITUDE CYCLONE:

This is a low pressure system that is associated with the warm and dominant cold front respectively.

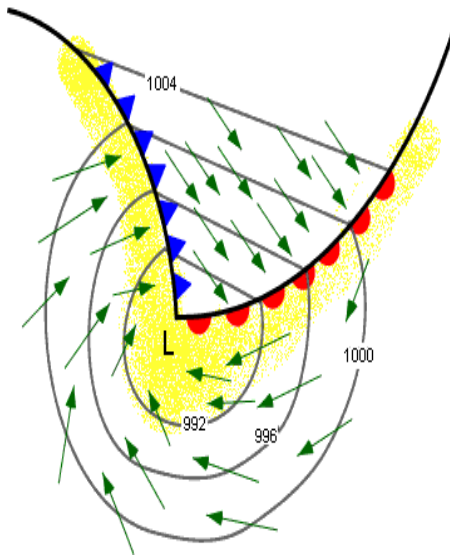
OTHER NAMES FOR MID LATITUDE CYCLONES ARE:

- FRONTAL DEPRESSION
- EXTRA TROPICAL CYCLONE
- TEMPERATE CYCLONE
- CYCLOGENESIS

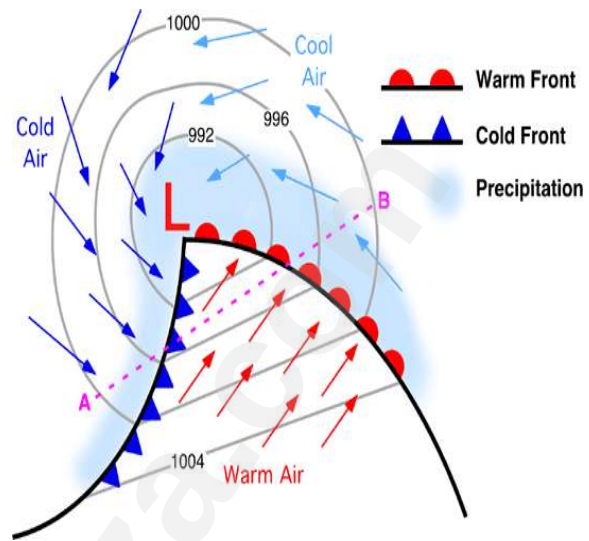
SPECIFIC CHARACTERISTICS FOR MID LATITUDE CYCLONE:

- Movement/Direction is from WEST TO EAST.
- Wind speed at about 30 km/h to 50 km/h.
- Life span 4 to 14 days.
- Diameter is up to 3000 km.
- Occurs in FAMILIES of 3 to 5 cyclones.
- Has warm and cold front.
- Has warm and cold sector.
- Occurs in the mid latitudes between 30 degrees and 60 degrees North and South of the Hemisphere.
- Affects South Africa in WINTER and SPRING (April to October).

- In the NORTHERN HEMISPHERE occurs from NOVEMBER to MARCH.
- The DOMINANT FRONT is the COLD FRONT. (i.e: this is because the warm front has already passed South Africa).



MID LATITUDE CYCLONE IN THE SOUTHERN HEMISPHERE.



MID LATITUDE CYCLONE IN THE NORTHERN HEMISPHERE.

WEATHER CHANGES CAUSED BY MID LATITUDE CYCLONES:

As the COLD FRONT moves over an area;

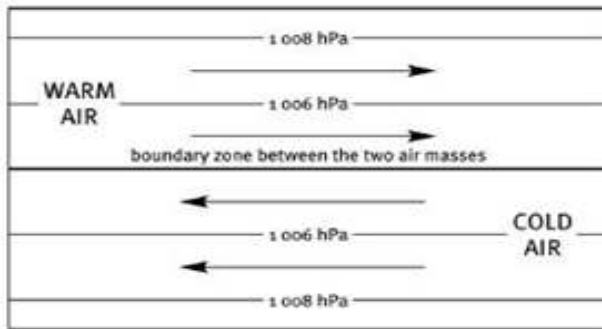
- A SUDDEN DECREASE IN THE TEMPERATURE.
- AIR PRESSURE INCREASE ON THE SURFACE.
- WIND DIRECTION CHANGES FROM NORTH WEST TO SOUTH WEST. (BACKING AND VEERING)
- WIND SPEEDS WILL BE VERY STRONG TO GALE FORCE.
- CUMULONIMBUS AND CUMULUS CLOUDS WILL BE FORMED.
- CUMULONIMBUS CLOUDS WILL LEAD TO HEAVY RAINFALL AND THUNDERSTORMS.
- HUMIDITY STARTS TO DECREASE.

DEVELOPMENT STAGES OF MID LATITUDE CYCLONE:

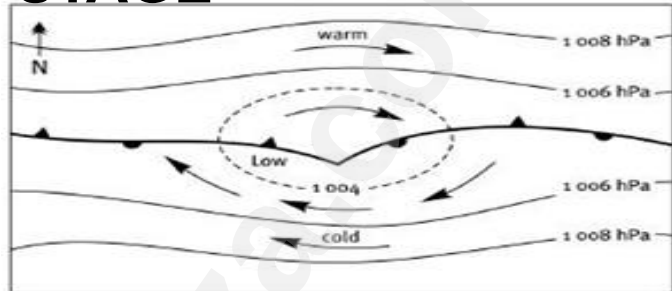
1. INITIAL STAGE – this is when the two different air masses (cold polar Easterlies and the warm Westerlies) do not mix at the POLAR FRONT.
2. DEVELOPMENT STAGE – this is when the two different air masses (cold easterlies and warm westerlies) cause friction and form a disturbance at the POLAR FRONT.
3. MATURE STAGE – this is when the fronts (cold and warm front) are clearly visible and the system rotates clockwise in the Southern Hemisphere.

4. **OCCLUSION STAGE** – this is when the **COLD FRONT** has caught up with the **WARM FRONT** causing the warm front to be pushed or lifted up, and both the fronts move as one mixed uniform front.
5. **DISSIPATING/ DECAY/ DEGENERATING STAGE** – this is when the warm air is completely lifted off the surface, and the pressure decreases/weakens and the cyclone dies.

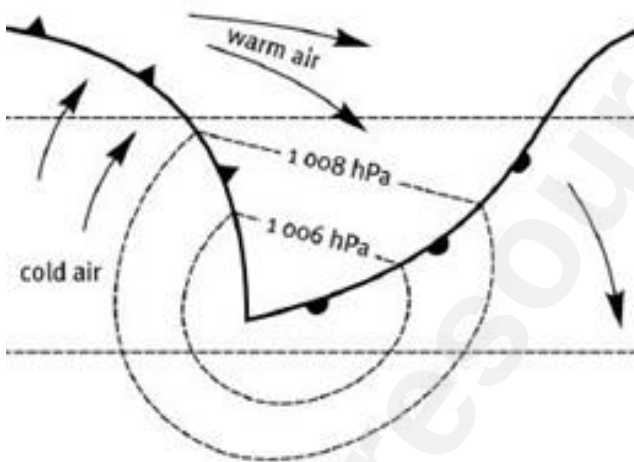
1. INITIAL STAGE



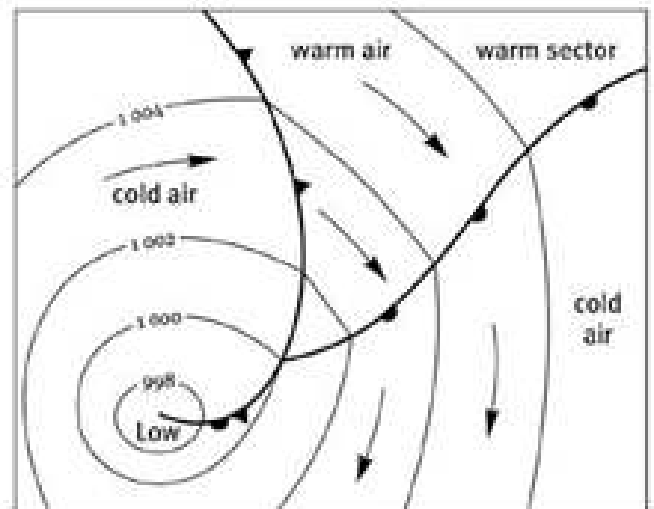
2. DEVELOPMENT STAGE

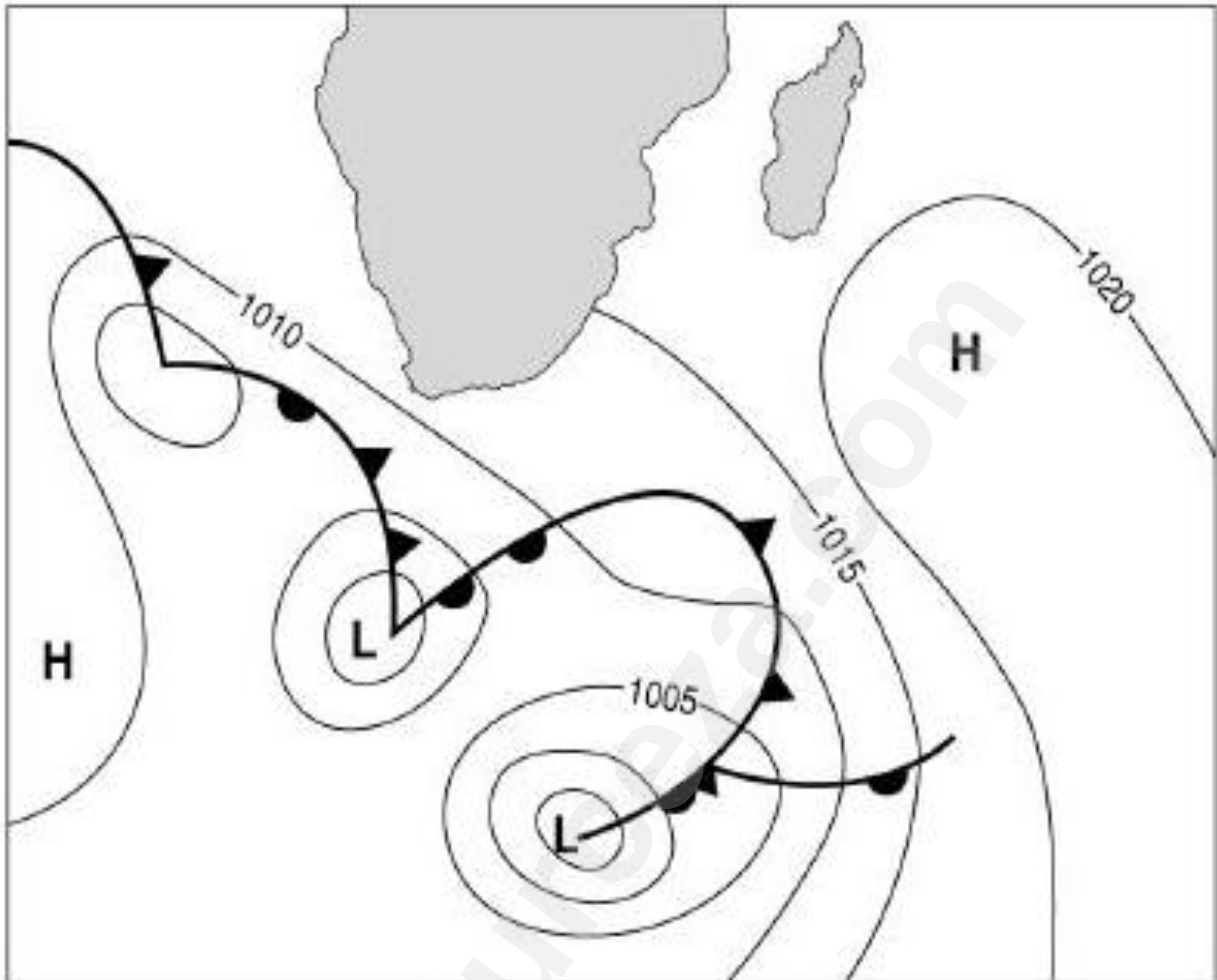


3. MATURE STAGE



4. OCCLUSION STAGE



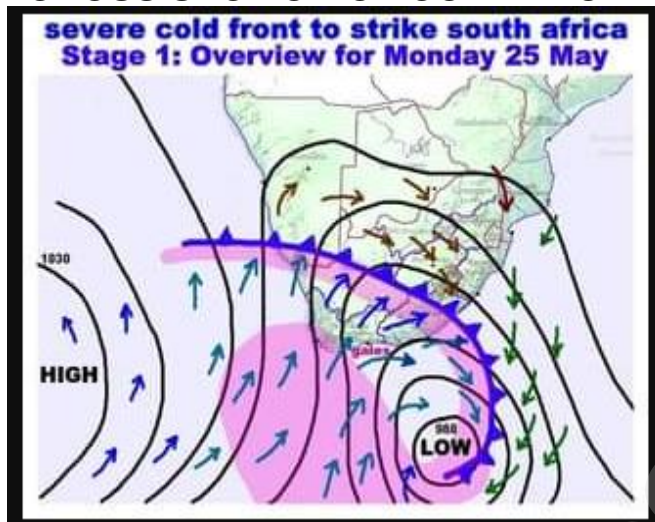


FAMILIES OF MID LATITUDE CYCLONES

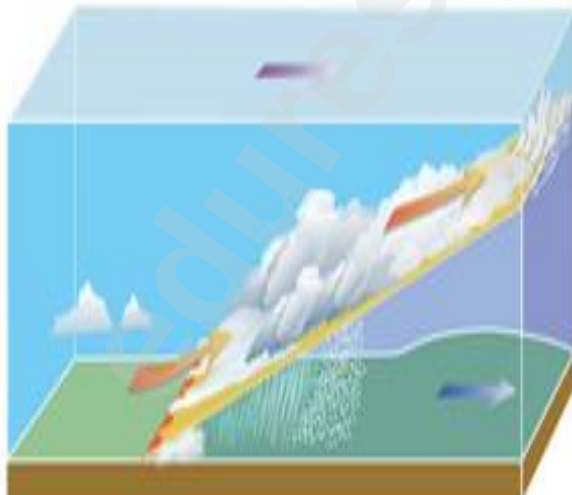
CROSS SECTION OF MID - LATITUDE CYCLONE



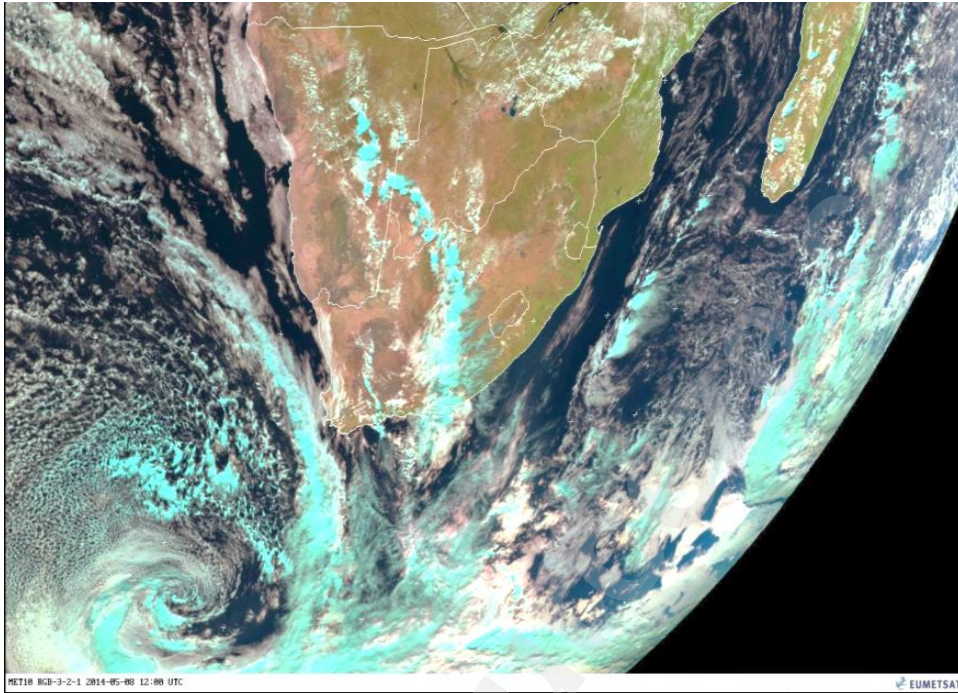
CROSS SECTION OF COLD FRONT



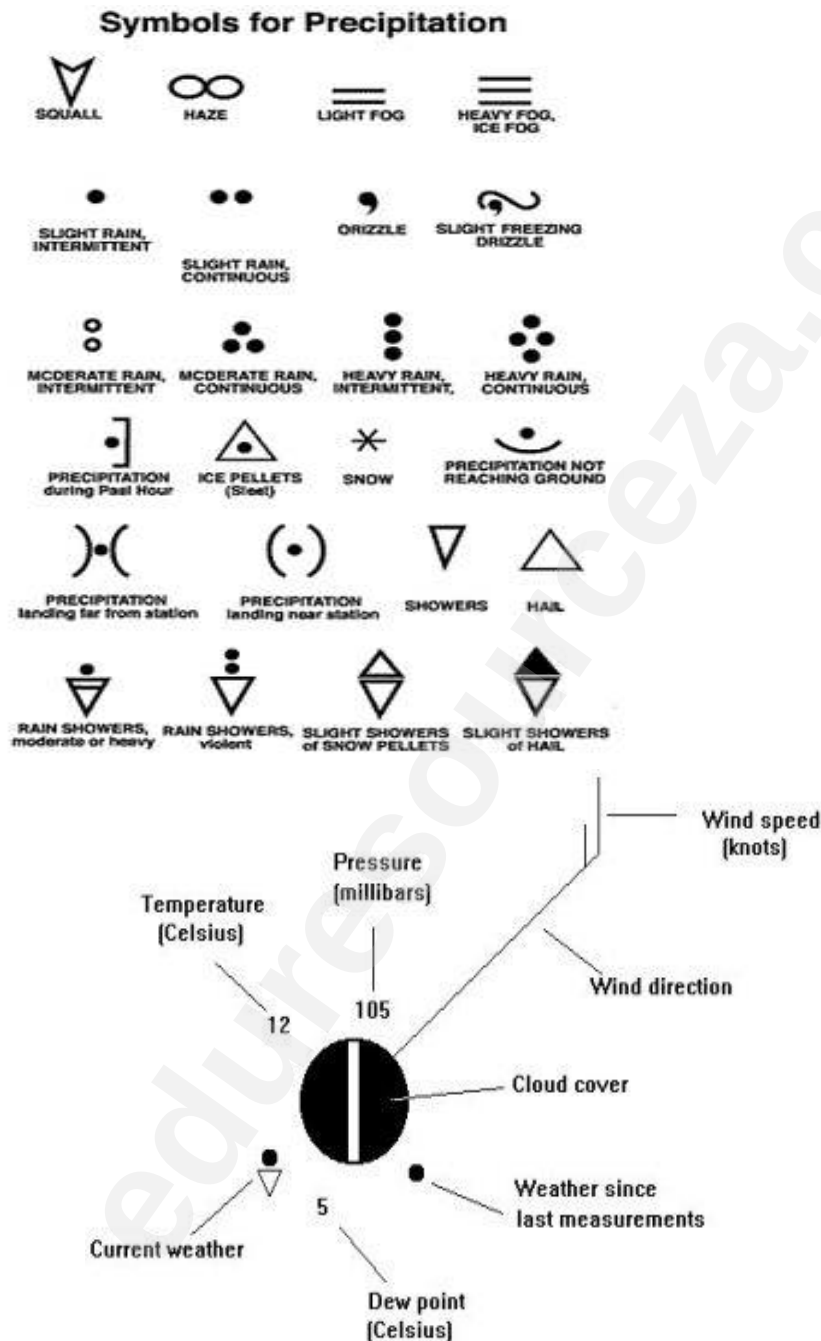
CROSS SECTION OF WARM FRONT



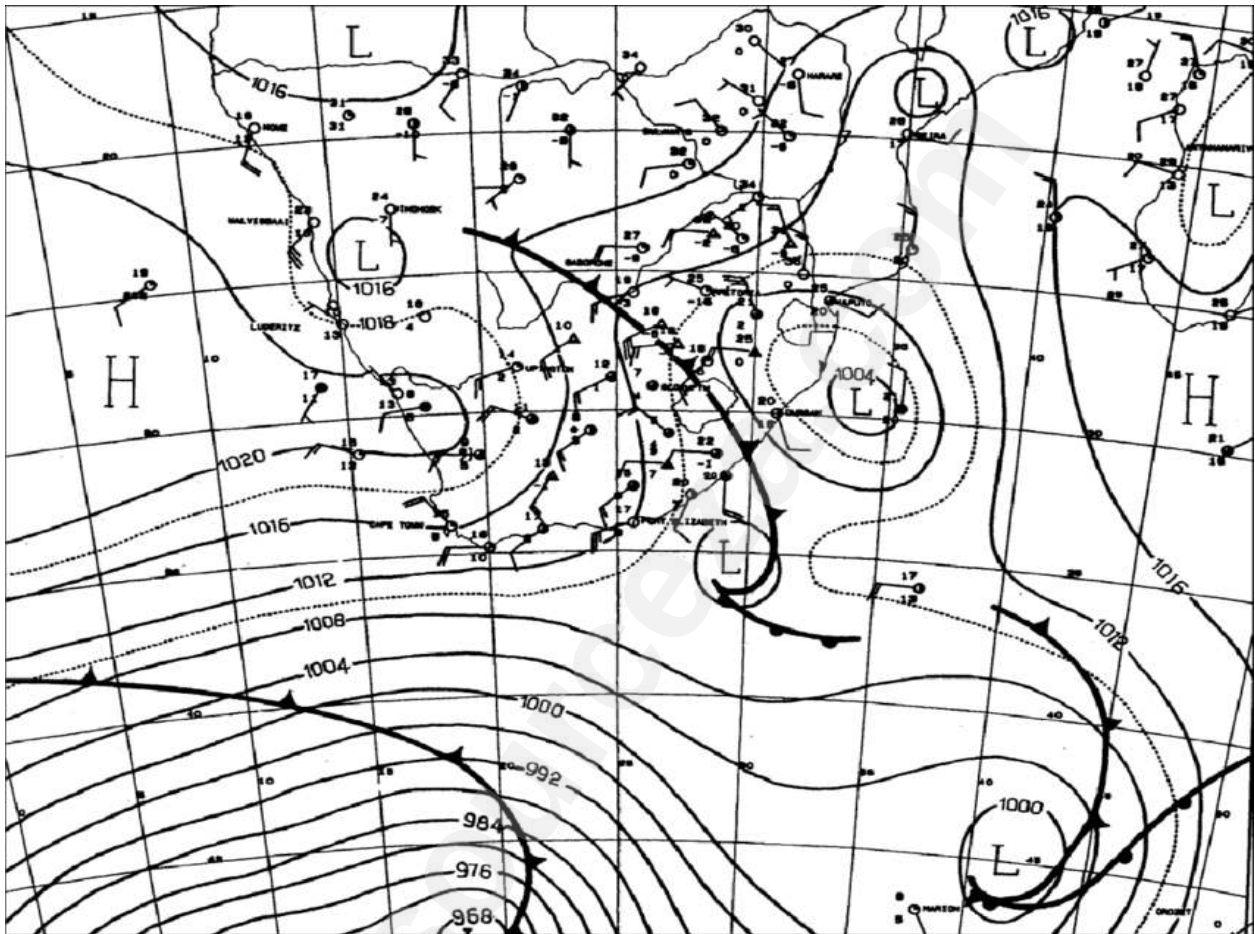
SATELLITE IMAGE OF A MIDLATITUDE CYCLON



STATION MODEL AND PRECIPITATION SYMBOLS



SYNOPTIC WEATHER MAP



IMPACT/EFFECTS OF MID LATITUDE CYCLONES

NEGATIVE IMPACT/EFFECTS:

- Very cold conditions leading to power cuts as people will be using more power to warm themselves.
- South westerly winds can create very strong conditions and gale force winds that will be dangerous to ship and the harbor.
- Heavy rain in the Western Cape leads to poor visibility and accidents.
- Can cause snow in the Western Cape that can lead to closing of mountain passes.
- Heavy rainfall in the Western Cape lead to floods that will destroy peoples' houses, crops, and livestock destroyed.
- Food insecurity due to a decrease in crop production (creates poverty).
- Loss of profit by South Africa's farmers.
- There is an in the imports than exports (balance of trade).

- Causes a decrease in the GDP, which leads to expensive food.

POSITIVE IMPACT/EFFECTS:

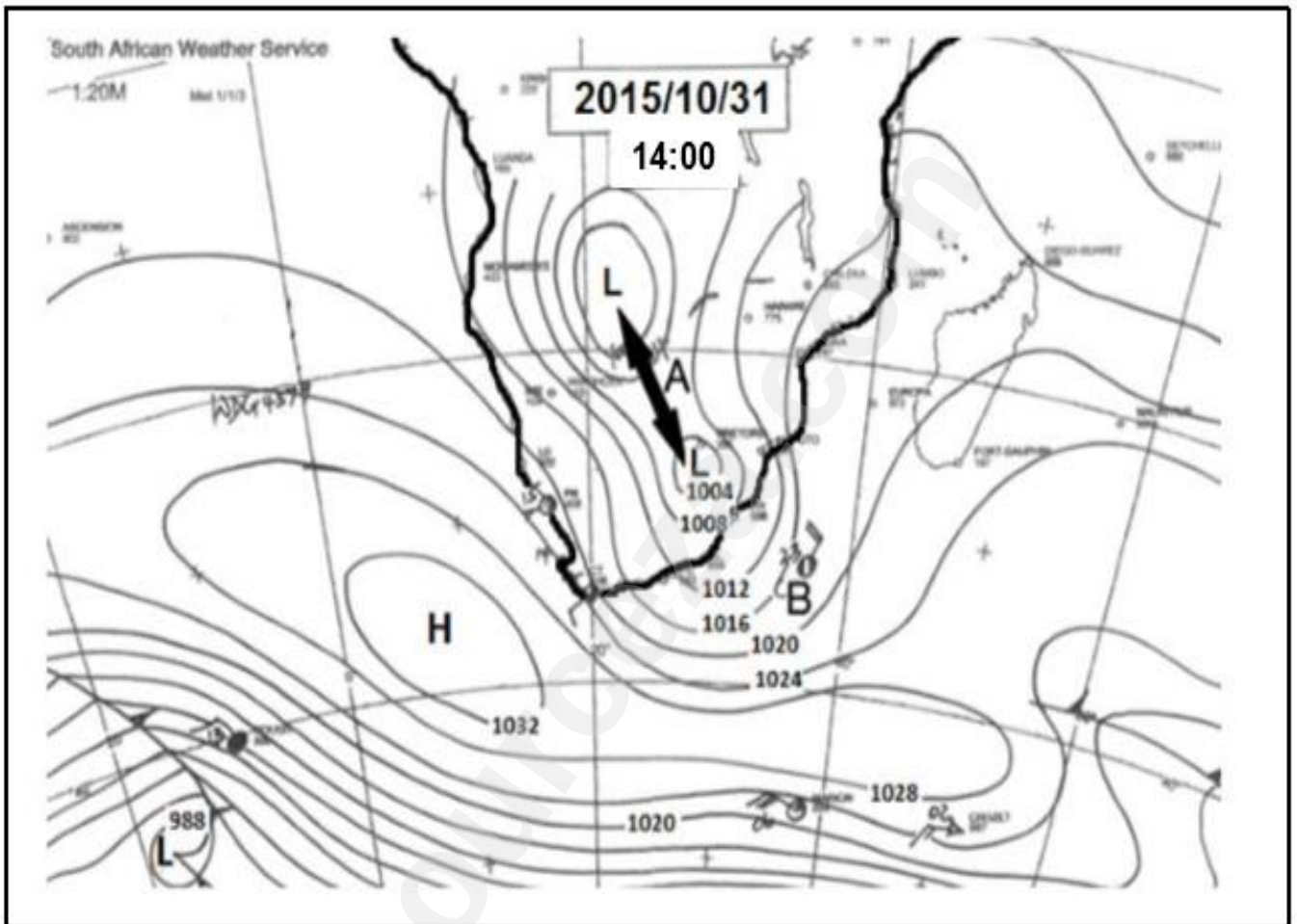
- Winter rainfall in the Western Cape brings more yields on crops, especially grapes (e.g: wine industry).
- Winter rainfall fills up the dams and brings more water for irrigation, industrial and domestic use.
- More profit to farmers due to more yields.
- Food security (availability of food).
- Creates employment.
- Increases the GDP of the country.
- Improves the marine eco-systems.

MID - LATITUDE CYCLONE QUESTIONS

FEB/ MARCH 2017

- 1.1 Refer to FIGURE 1.1 showing a synoptic weather map of southern Africa. 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.
- 1.1.1 The synoptic weather map data was captured at (12:00/14:00).
- 1.1.2 The season represented by this synoptic weather map is (summer/winter).
- 1.1.3 Area **A** on the synoptic weather map is a (ridge/trough).
- 1.1.4 The weather system associated with the area at **A** creates (stable/unstable) weather conditions.
- 1.1.5 The wind at weather station **B** is a (NNE/SSW) wind.
- 1.1.6 The wind speed at weather station **B** is (20/10) knots.
- 1.1.7 The air pressure at the centre of the South Atlantic anticyclone is (lower/higher) than 1 032 hPa/mb. (7 x 1) (7)

FIGURE 1.1: SYNOPTIC WEATHER MAP

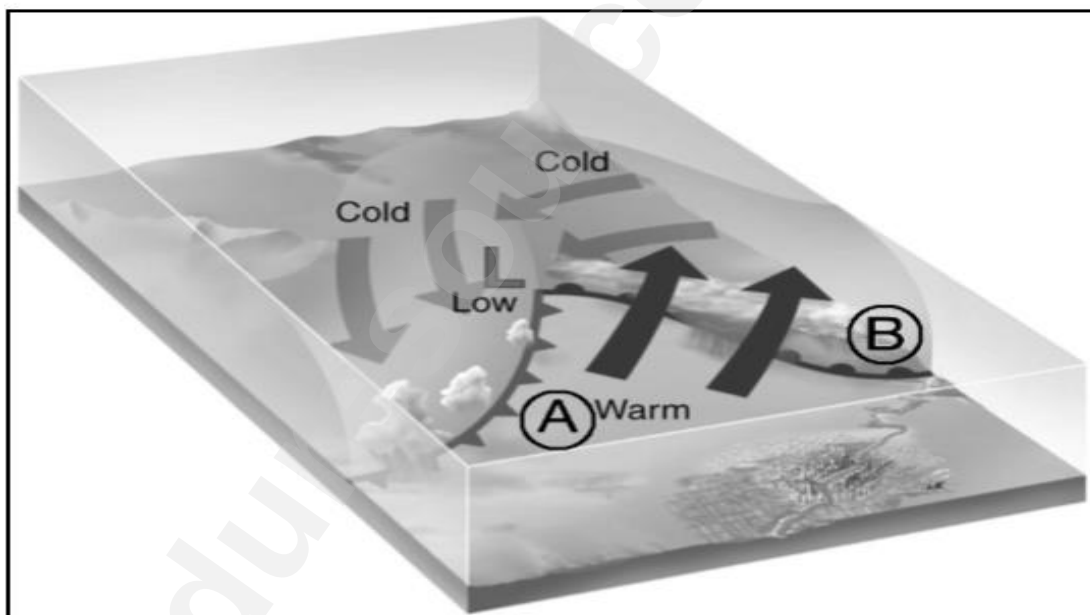


[Source: South African Weather Service]

FEB/ MARCH 2017

- 1.3 FIGURE 1.3 is a three-dimensional representation of a mid-latitude cyclone over the United States of America.
- 1.3.1 Name fronts **A** and **B**. (2 x 1) (2)
- 1.3.2 In what stage of development is this mid-latitude cyclone? (1 x 1) (1)
- 1.3.3 Give evidence in the diagram to prove that this mid-latitude cyclone occurs in the Northern Hemisphere. (1 x 2) (2)
- 1.3.4 Give a reason why front **B** is associated with a greater rainfall extent than front **A**. (1 x 2) (2)
- 1.3.5 Describe the likely weather conditions associated with the cloud type at front **A**. (2 x 2) (4)
- 1.3.6 Discuss TWO expected weather changes that could occur when the mid-latitude cyclone reaches the occlusion stage. (2 x 2) (4)

FIGURE 1.3: MID-LATITUDE CYCLONE OVER THE USA



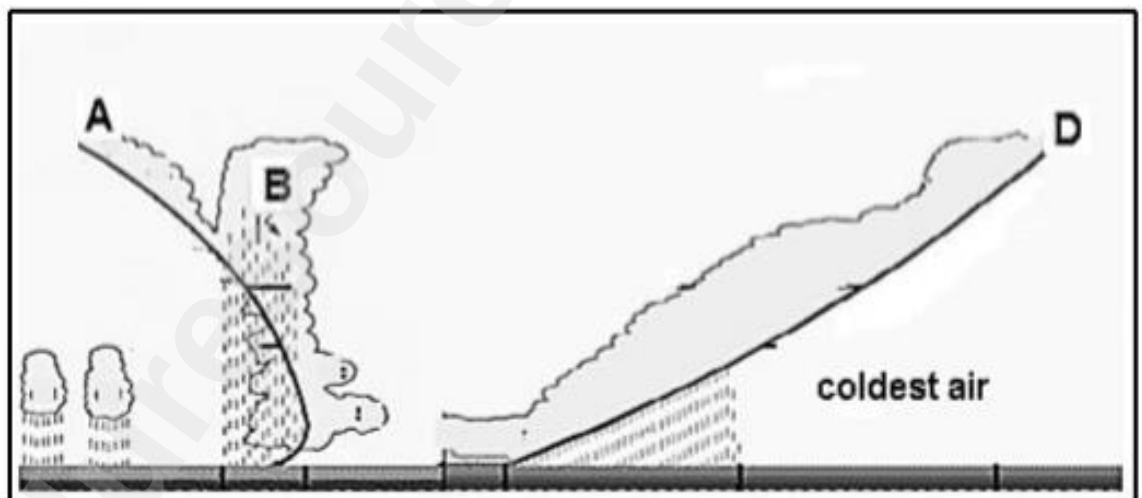
[Source: http://www.geog.ucsb.edu/~joel/g110_w08/lecture_notes/midlat_surface]

FEB/ MARCH 2018

2.3 Study FIGURE 2.3, a cross-section of a mid-latitude cyclone.

- | | | | |
|-------|---|---------|-----|
| 2.3.1 | Name front A . | (1 x 1) | (1) |
| 2.3.2 | (a) Name cloud type B . | (1 x 1) | (1) |
| | (b) Account for the type of cloud at B which is associated with this weather system. | (1 x 2) | (2) |
| 2.3.3 | Why does the warm front (D) seldom influence the weather of South Africa? | (1 x 2) | (2) |
| 2.3.4 | Tabulate TWO differences between a mid-latitude cyclone and a tropical cyclone regarding place of origin and the major wind belt steering it. | (2 x 2) | (4) |
| 2.3.5 | Explain why the next stage of development of this mid-latitude cyclone will be a warm front occlusion. | (2 x 2) | (4) |

FIGURE 2.3: A CROSS-SECTION OF A MID-LATITUDE CYCLONE

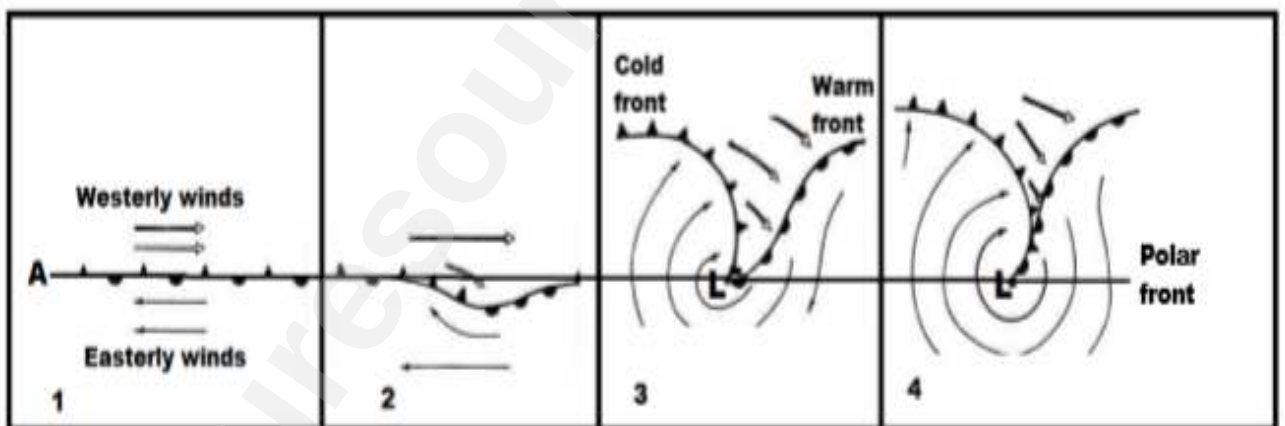


[Adapted from <http://isu.indstate.edu/ebermudez/hlth210/lesseightc.html>]

MAY/ JUNE 2016

- 2.1 Study FIGURE 2.1, based on stages in the development of a mid-latitude cyclone.
- 2.1.1 Which line of latitude, 20°S, 60°S or 80°S, is represented by line **A**?
 - 2.1.2 Is a mid-latitude cyclone a high-pressure system or a low-pressure system?
 - 2.1.3 Describe the circulation of the air, as shown in stage 2.
 - 2.1.4 Name the zone of separation between the westerly and easterly winds.
 - 2.1.5 Name the stage of development during which fronts form.
 - 2.1.6 Define the term *cold front*, seen in stage 3.
 - 2.1.7 Which stage (1, 2, 3 or 4) shows the mid-latitude cyclone in the occlusion stage?
 - 2.1.8 Give ONE point of evidence in the diagram that indicates that this cyclone occurs in the Southern Hemisphere. (8 x 1) (8)

FIGURE 2.1: STAGES IN THE DEVELOPMENT OF A MID-LATITUDE CYCLONE

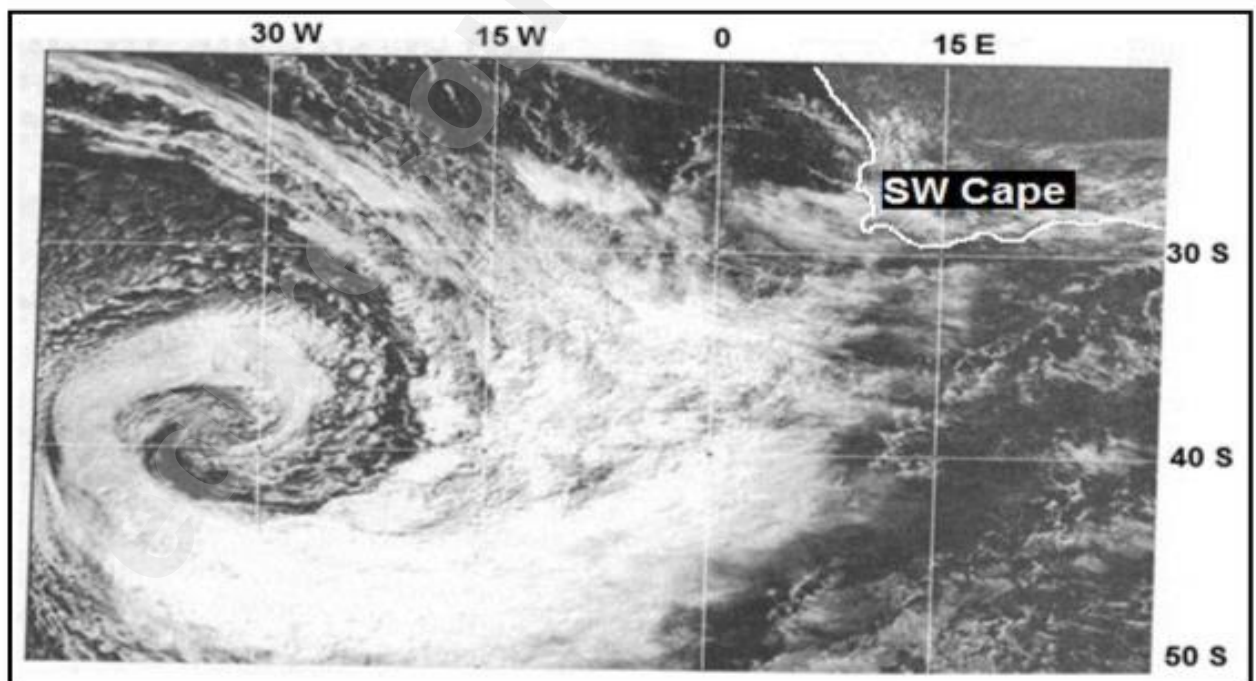


[Source: Examiner's own sketch]

MAY/ JUNE 2017

- 1.3 Refer to FIGURE 1.3 based on a satellite image.
- 1.3.1 Identify the low-pressure weather system shown in the satellite image. (1 x 1) (1)
 - 1.3.2 Give evidence from the satellite image to support your answer to QUESTION 1.3.1. (1 x 2) (2)
 - 1.3.3 Account for the direction in which this low-pressure weather system moves. (1 x 2) (2)
 - 1.3.4 Why does this low-pressure weather system have a greater impact on South Africa in the winter? (1 x 2) (2)
 - 1.3.5 Sketch a labelled cross-section of a cold front associated with this low-pressure weather system. (4 x 1) (4)
 - 1.3.6 Explain how this low-pressure weather system has a positive impact on the economy of the South-western Cape. (2 x 2) (4)

FIGURE 1.3: SATELLITE IMAGE



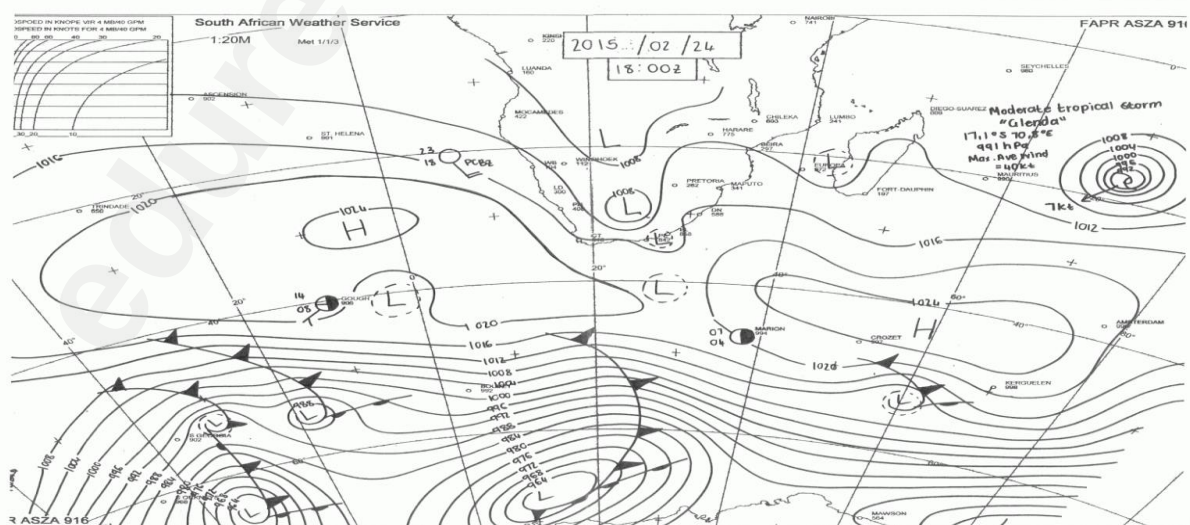
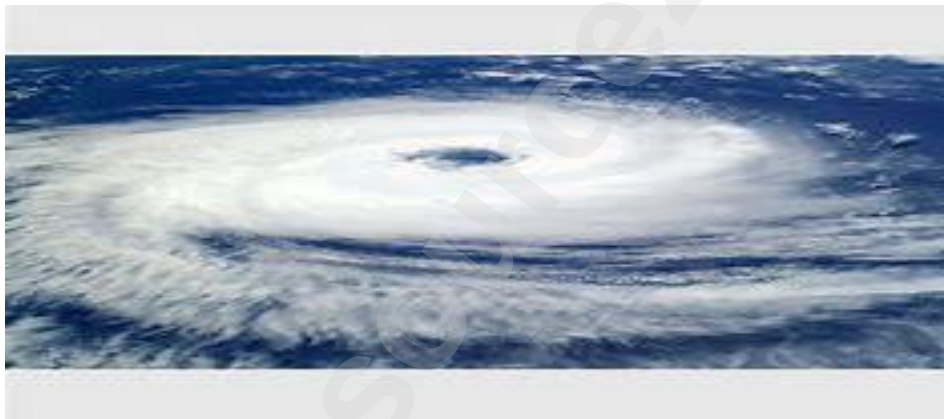
[Source: South African Weather Services]

TROPICAL CYCLONE

SPECIFIC CHARACTERISTICS:

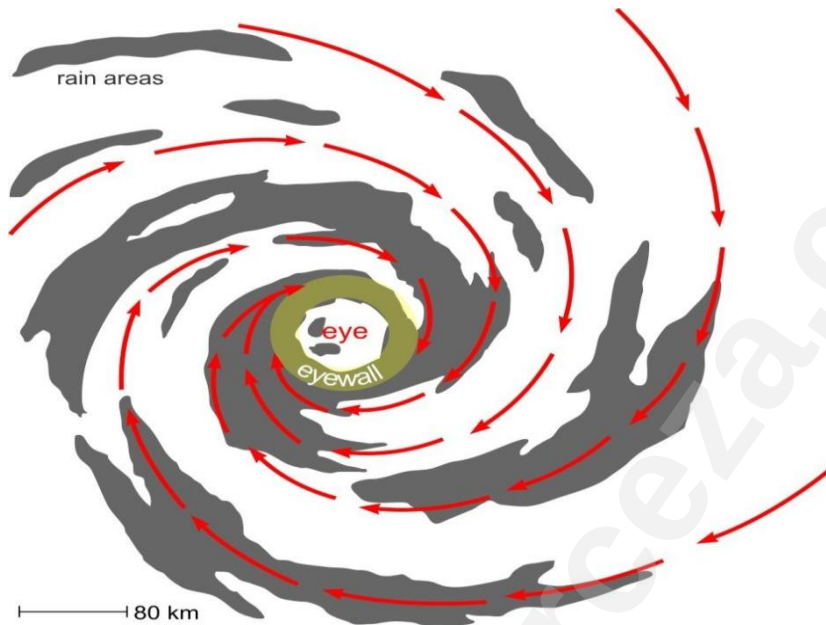
- Moves from East to West.
- The system moves with the speed of 20 km/h to 25 km/h.
- The wind moves/blows with the speed of about 200 km/h to 300 km/h.
- It has an EYE with a diameter of 30 km to 50 km (the pressure in the eye is below 1000 hPa).
- It has an eye wall with tall cumulonimbus clouds around the eye.
- The diameter of the tropical cyclone is 500 km.
- Has left hand quadrant in the Southern Hemisphere (most dangerous part of the system).
- Has a life span of more than a week.
- Tropical cyclones are named alphabetically, starting with alphabet "A".

Satellite Image of a Tropical cyclone

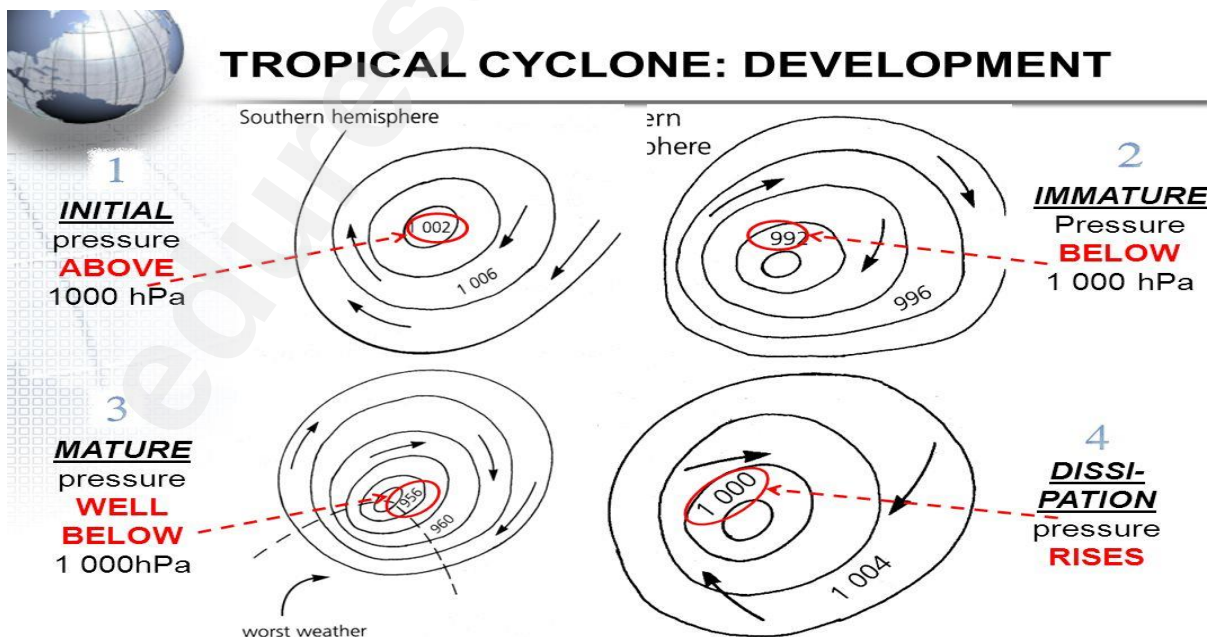


CONDITIONS/FACTORS NECESSARY FOR THE FORMATION OF TROPICAL CYCLONES:

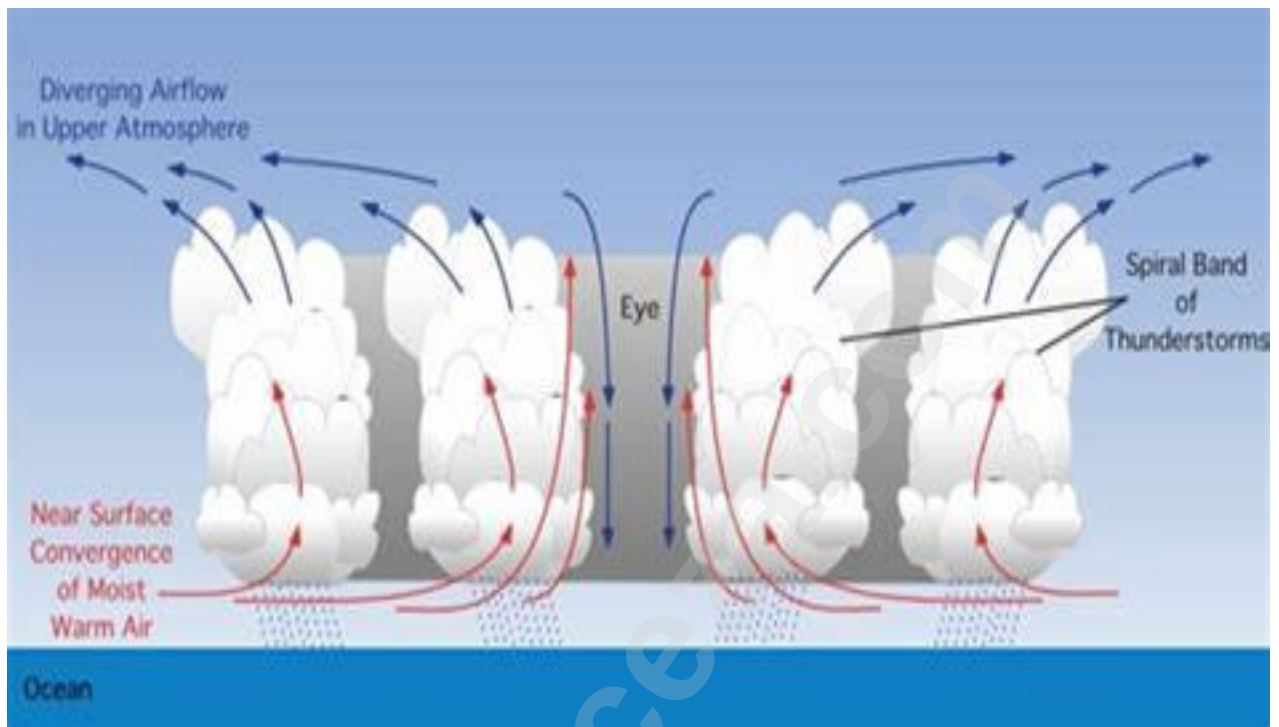
- Surface temperatures of about 27 degrees and above (water surface).
- High humidity (latent heat).
- Coriolis Force must be present.
- Intense (strong) low pressure cell.



STAGES OF DEVELOPMENT (TROPICAL CYCLONE)



CROSS SECTION OF A TROPICAL CYCLONE



IMPACT OF TROPICAL CYCLONES ON HUMANS AND THE ENVIRONMENT

HUMANS	ENVIRONMENT
Loss of lives	Storm surges – sudden rise in sea levels
Outbreak of water borne diseases like cholera since floods have damaged sewages.	Flooding caused by storm surge, heavy rains swollen rivers.
Disruption of tourism, trade, agriculture and industry.	Damage infrastructure like roads, bridges, homes, and sewage communication.
Loss of profit to farmers.	Fertile soil and crops are eroded away
Power lines are uprooted.	Trees are uprooted.
Food insecurity (less availability of food).	Destruction to the marine biodiversity.
Unemployment increases and exports decrease (decrease in the GDP of the country).	Destruction to the eco-system of the affected area.



PRECAUTIONARY MEASURES TO BE TAKEN BEFORE THE TROPICAL CYCLONE

- Putting early warning systems in place.
- Evacuation plans in place.
- Sand bags set on the beach line.
- Outreach programs/campaigns (educational).
- Extra health services available.
- Extra fire and rescue services available.
- Extra police and security services available.
- Tracking the system throughout the whole time.

NB: THESE ARE THE SAME FOR BOTH DEVELOPED AND DEVELOPING COUNTRIES; THEY BOTH DO THE SAME THING.

MANAGEMENT STRATEGIES AFTER THE SYSTEM HAS TAKEN PLACE

NB:

- ❖ **DEVELOPED COUNTRIES CAN DO THE FOLLOWING IN A VERY SHORT PERIOD OF TIME, DUE TO SUFFICIENT FUNDS.**
 - ❖ **DEVELOPING COUNTRIES WILL TAKE MUCH LONGER TO PERFORM THE FOLLOWING STRATEGIES, DUE TO INSUFFICIENT FUNDS.**
- Placement of people in the refugee camps/temporary shelters.
 - Distribution of medication to casualties.
 - Distribution of clean water.
 - Distribution of sanitary towels.
 - Availability of sanitation.
 - Health officials (Doctors and nurses) visiting campsites.
 - Distribution of food and clothes.
 - Construction projects start to rebuild infrastructure.

Category Stages

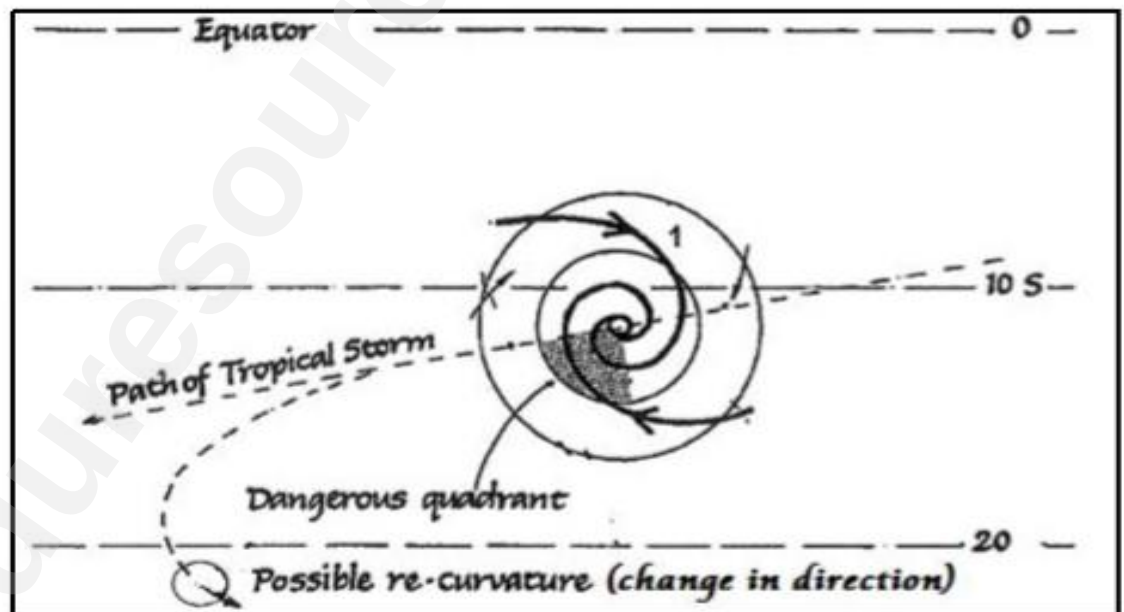
Category 1	Category 2	Category 3	Category 4	Category 5
Minimal damage	Moderate damage	Extensive damage	Extreme damage	Catastrophic
				
Winds 119-153 kph	Winds 154-177 kph	Winds 178-208 kph	Winds 209-251 kph	Winds 252 kph and more

Cyclone Category	Wind Speed in Km/h	Damage Capacity	Type of Disturbances	Wind Speed in Km/h
01	120-150	Minimal	Low Pressure	Less than 31
02	150-180	Moderate	Depression	31-49
03	180-210	Extensive	Deep Depression	49-61
04	210-250	Extreme	Cyclonic Storm	61-88
05	250 +	Catastrophic	Severe Cyclonic Storm	88-117
			Very Severe Cyclone	118-221
			Super Cyclone	More than 221

TROPICAL CYCLONE QUESTIONS

- 1.3 Refer to FIGURE 1.3 showing the path of a tropical cyclone.
- 1.3.1 In which general direction do tropical cyclones move? (1 x 1) (1)
- 1.3.2 What evidence suggests that this tropical cyclone is found in the Southern Hemisphere? (2 x 1) (2)
- 1.3.3 What causes the dangerous quadrant/semicircle to form? (1 x 2) (2)
- 1.3.4 Give ONE reason for the possible re-curvature (change of direction) of the tropical cyclone. (1 x 2) (2)
- 1.3.5 In a paragraph of approximately EIGHT lines, outline the associated weather with the dangerous quadrant/semicircle and its likely impact on coastal areas. (4 x 2) (8)

FIGURE 1.3: PATH OF A TROPICAL CYCLONE

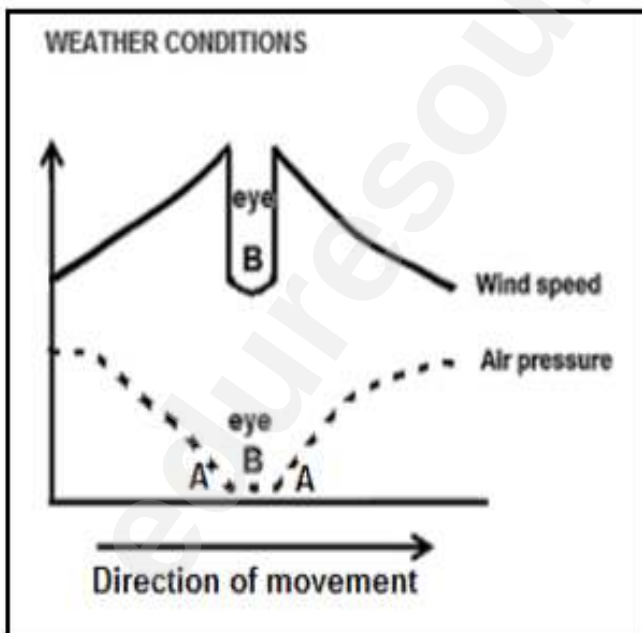


[Source: <http://about.metservice.com/assets/Learning-Centre/Mariners-Met-Pack-South-West-Pacific-ch5-Tropical-Cyclones.pdf>]

NOVEMBER 2016

- 1.1 Refer to FIGURE 1.1 showing a graph of weather conditions in the mature stage of development of a tropical cyclone.
- 1.1.1 State the type of precipitation at **A**.
- 1.1.2 State where the highest wind speed is recorded in the graph.
- 1.1.3 Name the main cloud type that surrounds area **B**.
- 1.1.4 Give the term that describes air movement towards **B**.
- 1.1.5 Give a reason for the air movement at **B**.
- 1.1.6 In which area does the tropical cyclone experience the lowest pressure?
- 1.1.7 Why does air descend in area **B**? (7 x 1) (7)

FIGURE 1.1: MATURE STAGE OF DEVELOPMENT OF A TROPICAL CYCLONE



[Source: Examiner's own sketch]

SEPTEMBER 2018 (KWAZULU NATAL)

FIGURE 2.3: CYCLONE JOYCE AND THE SAFFIR-SIMPSON SCALE

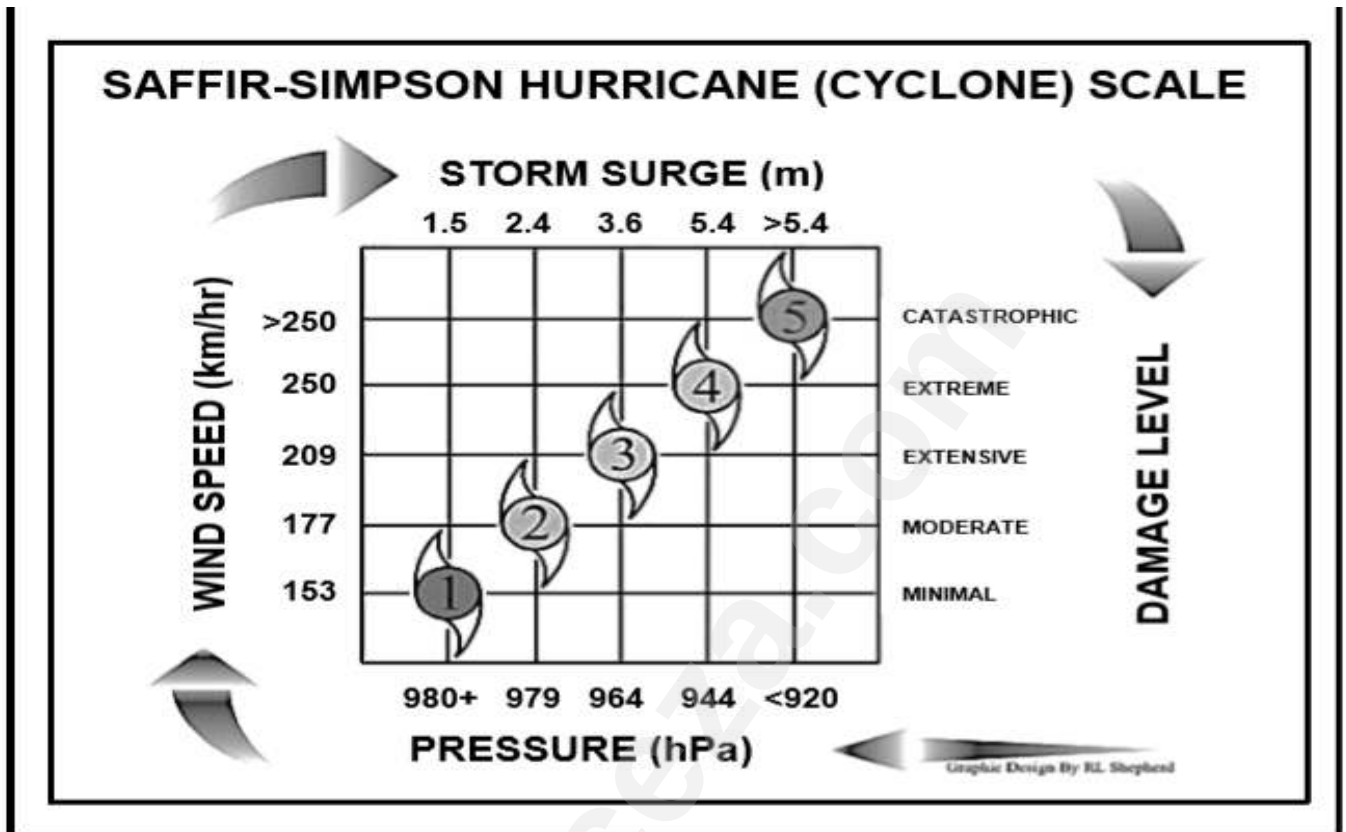
**TROPICAL CYCLONE JOYCE FAILS TO INTENSIFY OFF THE
WESTERN AUSTRALIAN COAST**

12 JANUARY 2018

Joyce was declared a category one cyclone with winds of 65km/h, and had been forecast to grow to a far more dangerous category three storm.

A flood warning was placed for the western Kimberley district as well as for the residents in De Grey catchment area. Heavy rain was likely to continue and winds were expected to reach 180km/h The cyclone however, reached land sooner than expected and failed to intensify to a category three storm as predicted.

<https://www.theguardian.com>



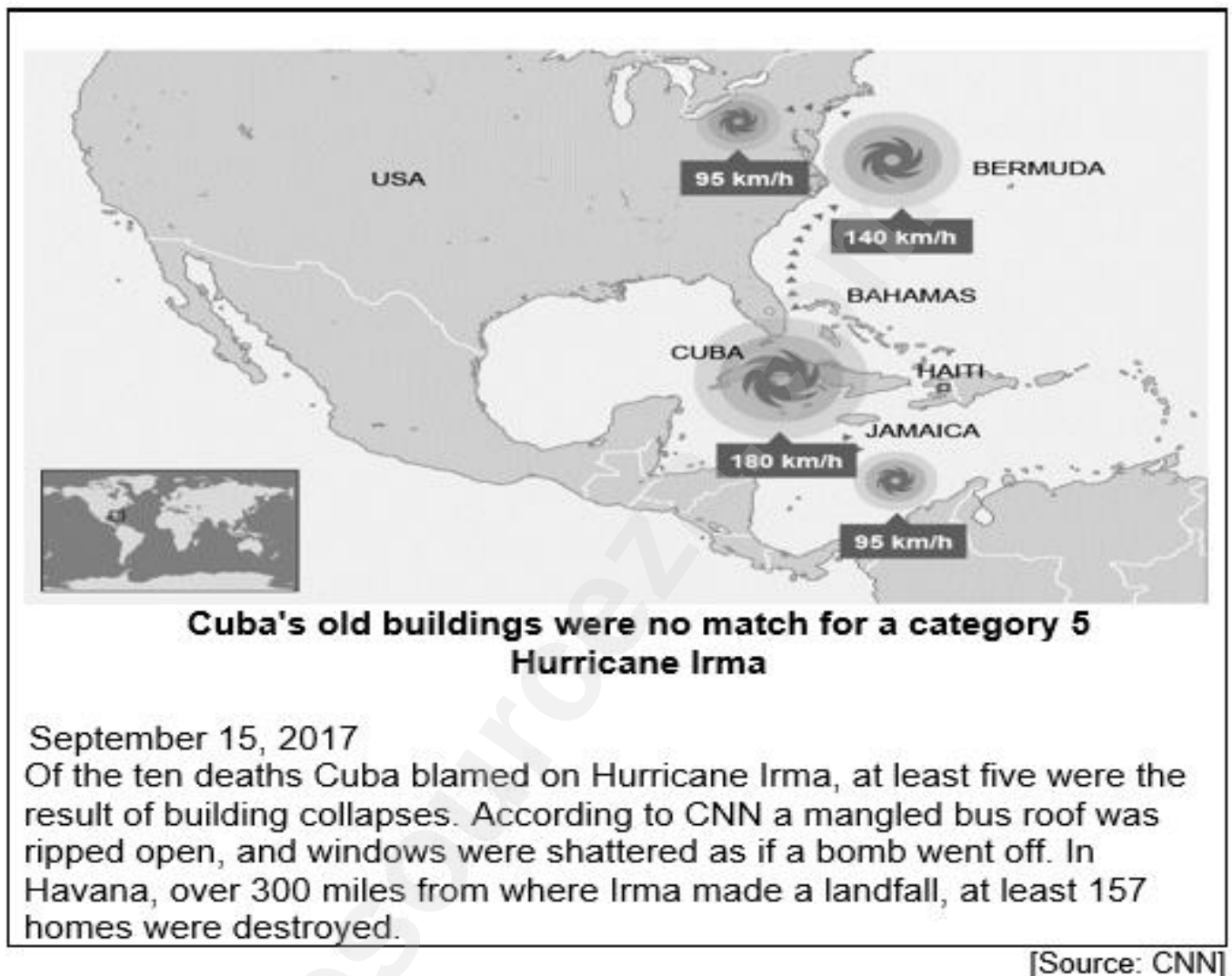
Source: Google upload

SEPTEMBER 2019 (FREE STATE)

2.3 Study FIGURE 2.3 on Hurricane Irma.

- 2.3.1 Which country was hit the most by the Hurricane Irma? (1 x 1) (1)
- 2.3.2 Give TWO pieces of evidence from FIGURE 2.3 that Hurricane Irma occurred in the Northern hemisphere. (2 x 1) (2)
- 2.3.3 Describe the damage caused by Hurricane Irma as a category 5 storm. (2 x 2) (4)
- 2.3.4 Explain the possible conditions that led to the development of Hurricane Irma. (2 x 2) (4)
- 2.3.5 Evaluate strategies that Cuba could consider to help prepare for and manage the effects of hurricanes. (2 x 2) (4)

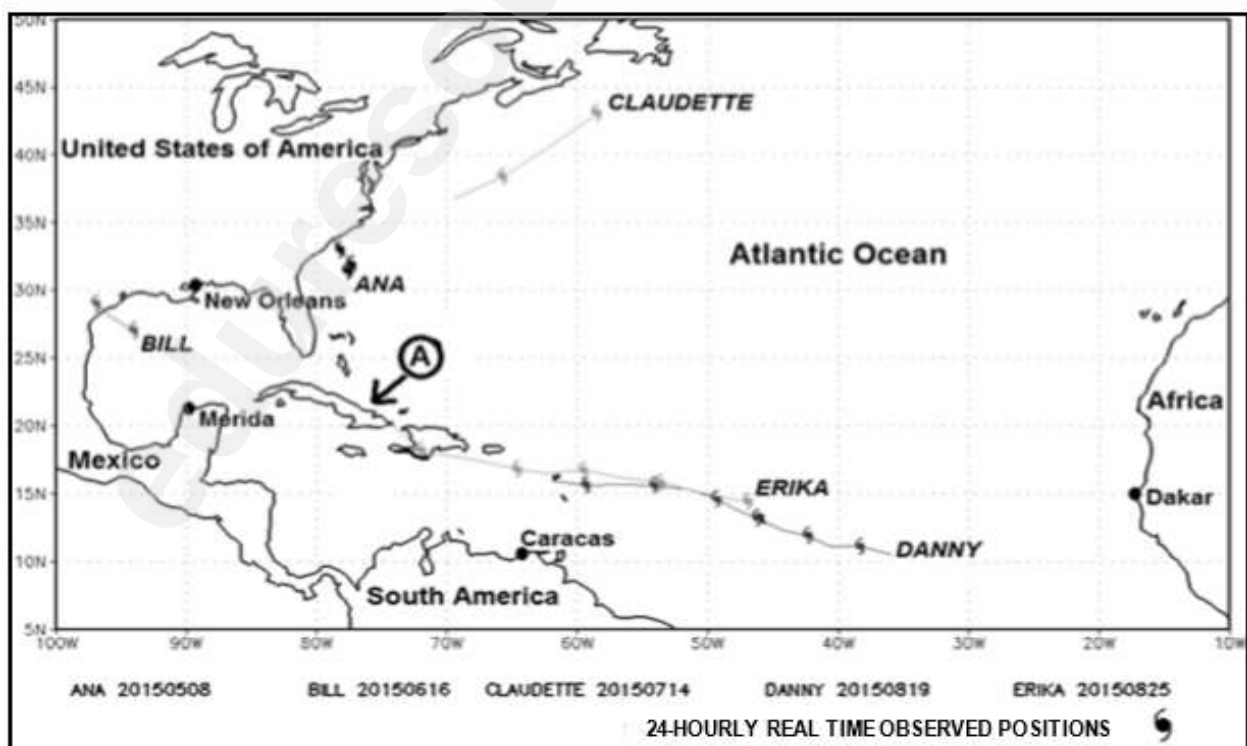
..FIGURE 2.3. HURRICANE IRMA



FEB/ MARCH 2017

- 2.3 Study FIGURE 2.3 showing the observed tracks of tropical cyclones in the USA.
- 2.3.1 How many tropical cyclones occurred in the 2015 season? (1 x 1) (1)
- 2.3.2 Why do tropical cyclones move in a westerly direction? (1 x 1) (1)
- 2.3.3 Give the term used to refer to tropical cyclones in this part of the world. (1 x 1) (1)
- 2.3.4 Discuss TWO conditions that promote the development of tropical cyclones. (2 x 2) (4)
- 2.3.5 The path of a tropical cyclone can be very erratic (unpredictable). In a paragraph of approximately EIGHT lines, give possible reasons for the erratic path they follow and why this creates problems for disaster management teams to effectively manage the impact of tropical cyclones. (4 x 2) (8)

FIGURE 2.3: TRACKS OF TROPICAL CYCLONES IN THE USA

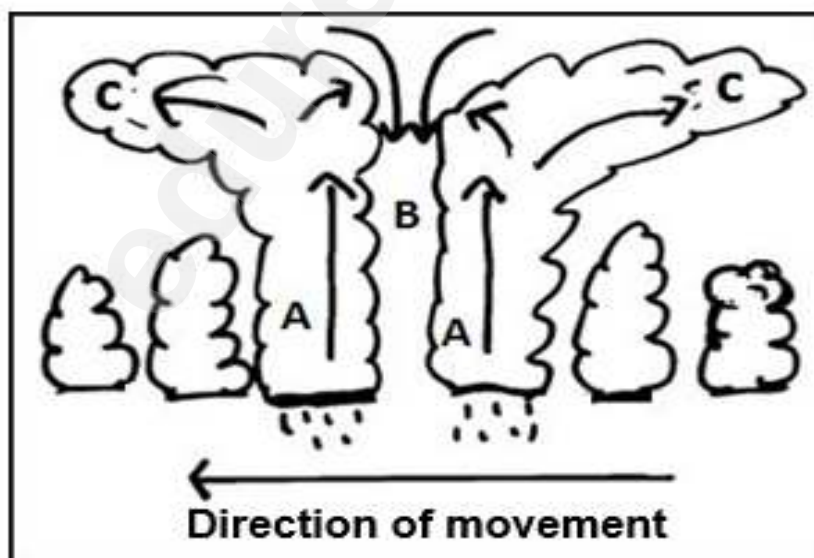


[Adapted from <http://www.metoffice.gov.uk/data/tropicalcyclone/tctracks/nat15.gif>]

NOVEMBER 2014

- 1.1 Study FIGURE 1.1 based on a cross-section of a tropical cyclone and answer the questions that follow.
- 1.1.1 Name cloud type **A**.
- 1.1.2 What is the name given to area **B** in the tropical cyclone?
- 1.1.3 Is the air pressure high or low in area **B**?
- 1.1.4 In which general direction do tropical cyclones travel in the Southern Hemisphere?
- 1.1.5 State the precipitation associated with cloud **A**.
- 1.1.6 Name the air movement in area **B**.
- 1.1.7 Is the air converging or diverging in area **C**?
- 1.1.8 What is the name given to the stage of development when a tropical cyclone moves inland? (8 x 1) (8)

FIGURE 1.1: CROSS-SECTION OF A TROPICAL CYCLONE



[Source: Examiner's own sketch]

ANTICYCLONES (HIGH PRESSURE CELLS) IN SOUTH AFRICA

These are the three HIGH PRESSURE CELLS found within the South African latitudes, namely:

1. SOUTH ATLANTIC HIGH PRESSURE CELL (ST HELENA H.P CELL)
2. KALAHARI HIGH PRESSURE CELL (CONTINENTAL H.P CELL)
3. SOUTH INDIAN HIGH PRESSURE CELL (MORITIOUS H.P CELL)

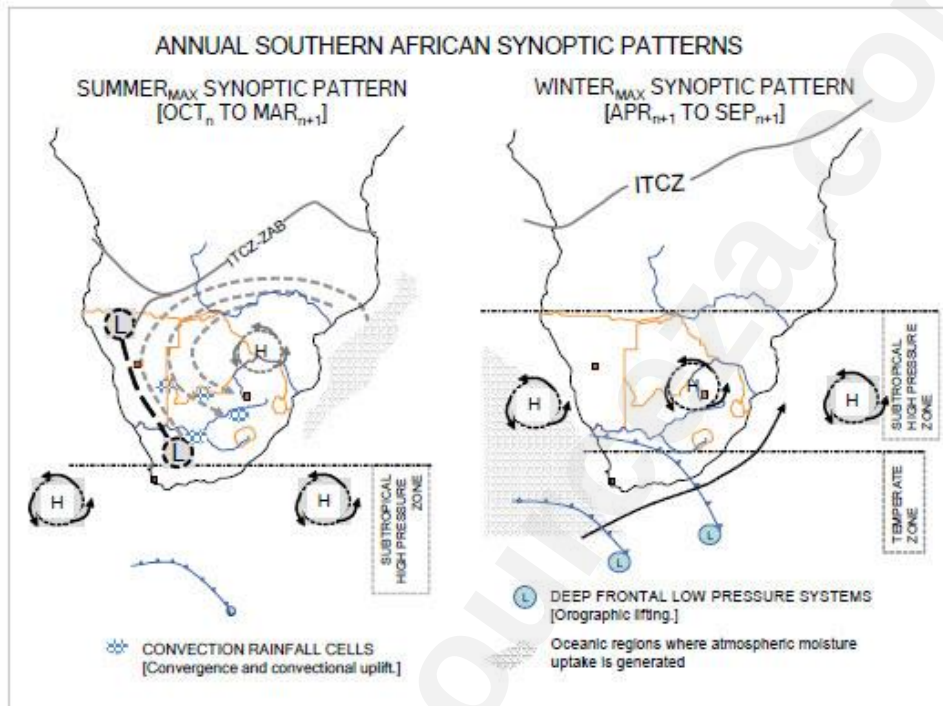


Figure 1
Synoptic patterns over Southern Africa during summer and winter seasons in relation to the generation of airborne moisture and the general migration pathways

CHARACTERISTICS OF SUBTROPICAL HIGH PRESSURE CELLS (ANTICYCLONES):

- Their rotation is anticlockwise in the Southern Hemisphere and clockwise in the Northern Hemisphere.
- They are associated with subsiding air.
- Subsiding air warms up adiabatically.
- They tend to bring clear, calm weather conditions.
- They are found between Tropic of Cancer/Capricorn (40 degrees N/S).

THE INFLUENCE OF THE ANTICYCLONES ON THE WEATHER OF SOUTH AFRICA

1. SOUTH ATLANTIC ANTICYCLONE:

- This system lies further South in summer.
- When the system ridges to the south of the country ahead of the frontal depression, it deflects the depression in a South East direction and prevents it from reaching the land.
- When the system ridges in behind the cold front it reinforces the SW air flow behind the front, and pushes it across the land.
- If this High pressure cell ridges into the south of the country and extends far east, it may result in a Black South Easter (winds that causes Torrential rainfalls).
- This system is responsible for dry weather conditions on the west coast, due to:
 - ✓ The descending which warms adiabatically.
 - ✓ The anticlockwise circulation of the air around this anticyclone causes South Westerly winds, hence the formation of fog.

2. KALAHARI ANTICYCLONE:

- This anticyclone exists over the interior, and dominates weather conditions in South Africa.
- This anticyclone is higher in the atmosphere in summer and is lower and stronger in winter.

SUMMER CONDITIONS:

- ✓ The plateau is warm and the air above it rises.
- ✓ The inversion layer lies above the escarpment.
- ✓ Most air from the Indian Ocean can rise above the escarpment on to the plateau.

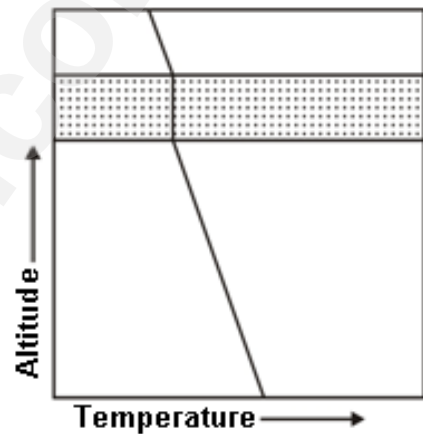
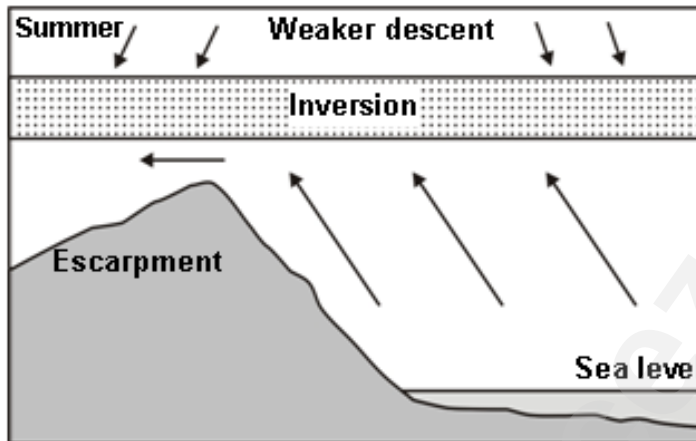
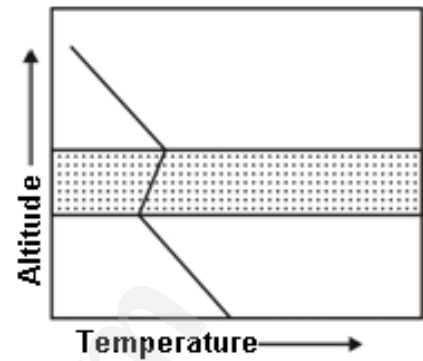
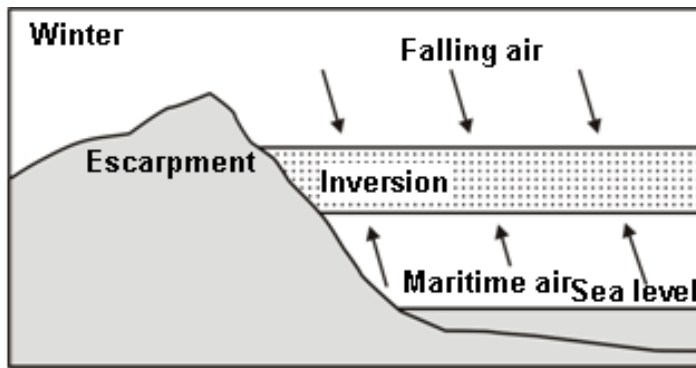
WINTER CONDITIONS:

- ✓ This system causes cloudless, dry conditions during winter.
- ✓ The descending air from the anticyclone warms adiabatically and all moisture evaporates.
- ✓ The plateau is cold and there is no rising air to lift the descending air of the anticyclone.
- ✓ Frost is very common on the High Veld due to;

A – the long cloudless nights, resulting in Terrestrial radiation.

B – calm conditions.

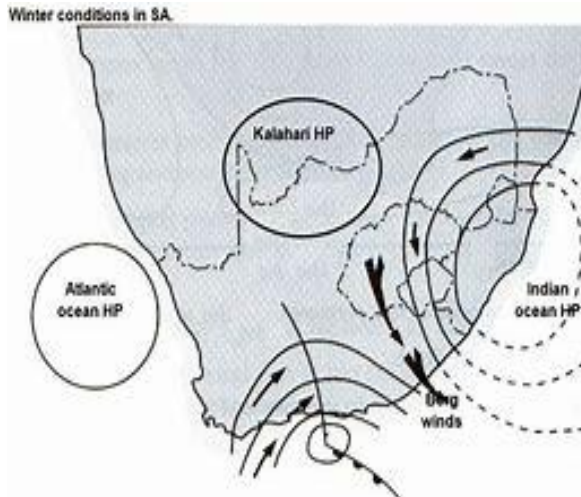
C – low humidity.



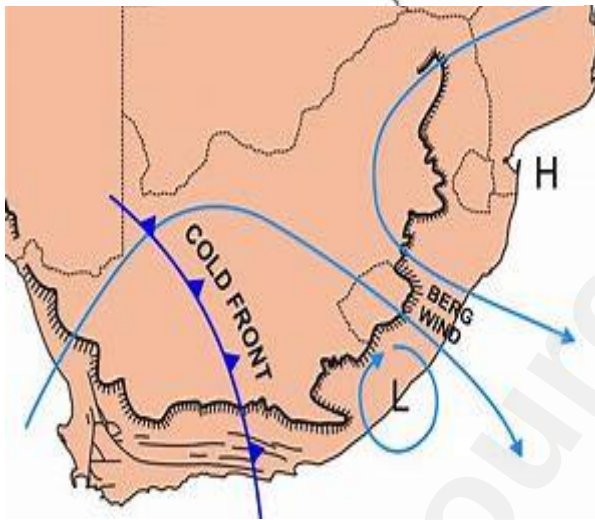
COASTAL LOW AND BERG WINDS

COASTAL LOW PRESSURE	BERG WINDS
These are low pressure cells that often travel ahead of cold fronts.	Berg winds are Hot dry winds that blow from the interior towards the coast and are warmed up adiabatically as they descend 1° C/100m.
They form off the west coast and travel east along the coast and change the coastal weather.	High pressure develops in the interior and low pressure over the coast.
Rotation is clockwise with onshore winds on the western side that bring rain and fog. Offshore winds on the eastern side with warm, dry conditions and they bring drizzle (misty).	Temperature drops fast by the cold air behind the front, and the difference in the pressure between the interior and the coast ceases (stops).
	They occur in winter.
	They cause veld fires. i.e – solution for VELD FIRES is the Fire fighters and the approaching Cold front.

BERG WINDS



COASTAL LOW



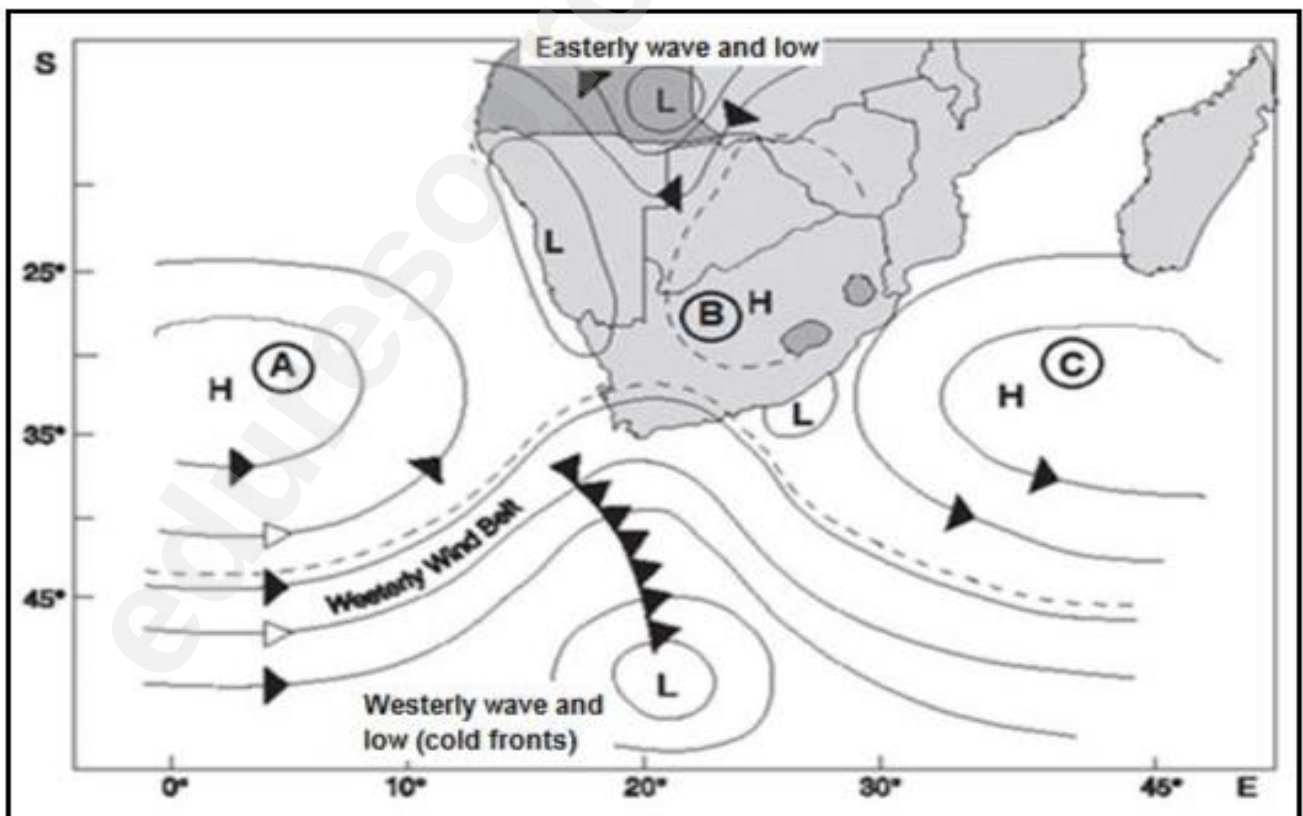
QUESTIONS ON ANTICYCLONES(HIGH PRESSURE CELLS)

FEB/ MARCH 2017

2.4 Refer to FIGURE 2.4 showing anticyclones over southern Africa.

- 2.4.1 Name high pressure cell **B**. (1 x 1) (1)
- 2.4.2 Why does high pressure cell **B** dominate the interior of South Africa in winter? (1 x 2) (2)
- 2.4.3 Give a reason for the lack of rainfall associated with high pressure cell **A**. (1 x 2) (2)
- 2.4.4 Explain the change in the position of the anticyclones over South Africa between summer and winter. (2 x 2) (4)
- 2.4.5 Explain why the South Indian High Pressure Cell feed more moist air over the interior in summer than in winter. (3 x 2) (6)

FIGURE 2.4: ANTICYCLONES OVER SOUTHERN AFRICA



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

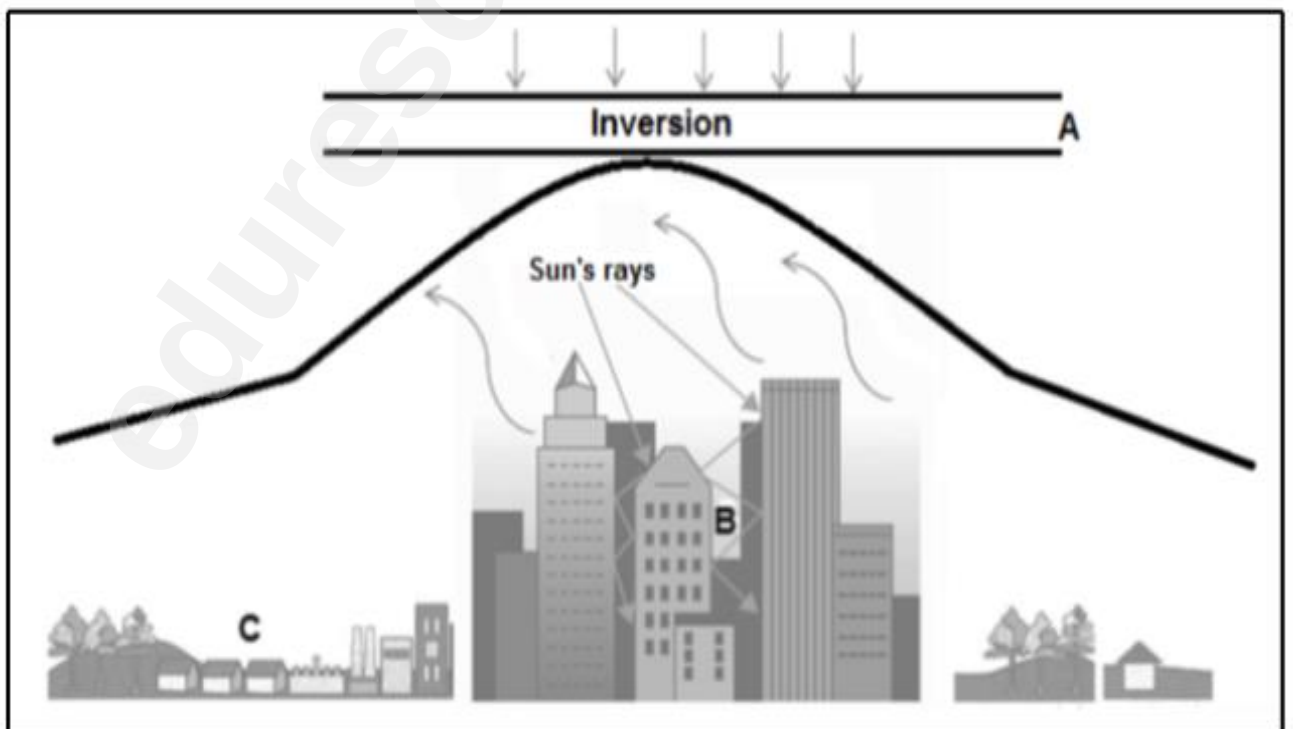
NOVEMBER 2016

2.1 Refer to FIGURE 2.1 on city climates.

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.

- 2.1.1 The sketch shows a (day/night) situation.
- 2.1.2 The inversion layer is found at a (higher/lower) altitude during the night.
- 2.1.3 The inversion layer (increases/decreases) pollution concentration over the city during the night.
- 2.1.4 The heating of the city at **B** is the result of (multiple reflections of heat/terrestrial radiation).
- 2.1.5 The channelling of wind between tall buildings (increases/decreases) the wind speed.
- 2.1.6 Temperature (increases/decreases) from **B** to **C**.
- 2.1.7 The influence of evapotranspiration on cooling the air will be (less/more) at **B** compared to **C**.
- 2.1.8 Area **B** is associated with (more/less) cloud coverage compared to area **C**. (8 x 1) (8)

FIGURE 2.1: CITY CLIMATES



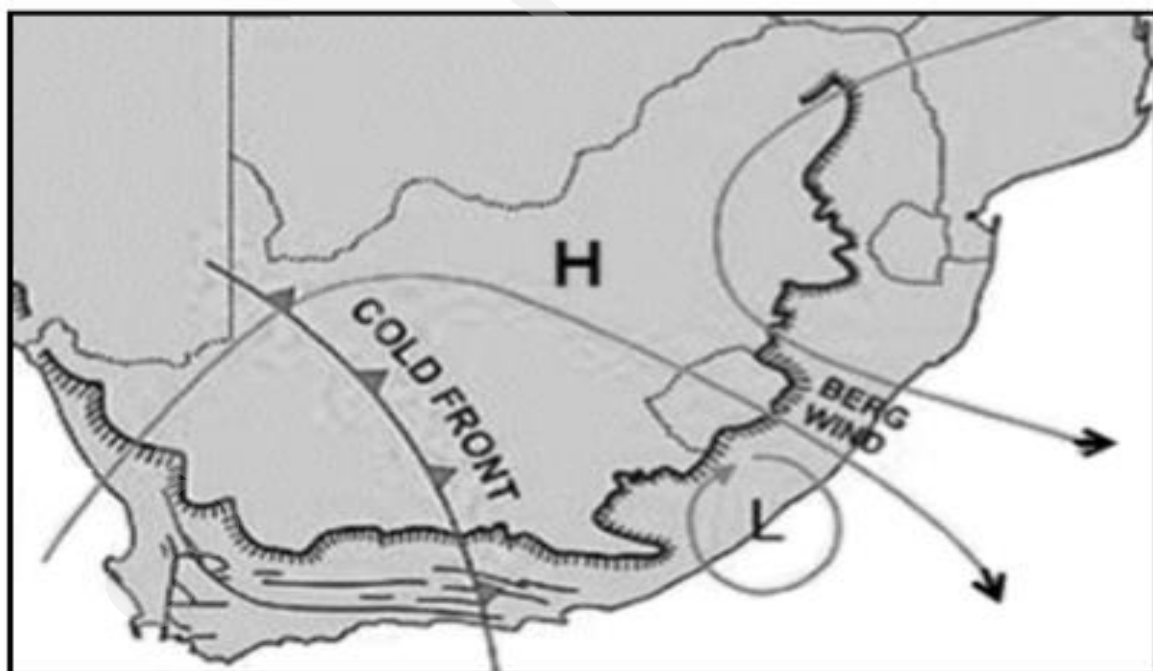
[Source: Examiner's own sketch]

NOVEMBER 2016

1.3 FIGURE 1.3 is a sketch map showing berg-wind conditions.

- 1.3.1 Name TWO conditions visible on the sketch map, that are necessary for berg winds to form. (2 x 1) (2)
- 1.3.2 Draw a labelled cross-section to explain the formation of berg winds along the east coast of South Africa. (4 x 1) (4)
- 1.3.3 Why are berg winds most likely to occur in winter? (1 x 2) (2)
- 1.3.4 In a paragraph of approximately EIGHT lines, explain why berg winds are regarded as a threat to farming communities along the east coast of South Africa. (4 x 2) (8)

FIGURE 1.3: BERG WIND CONDITIONS

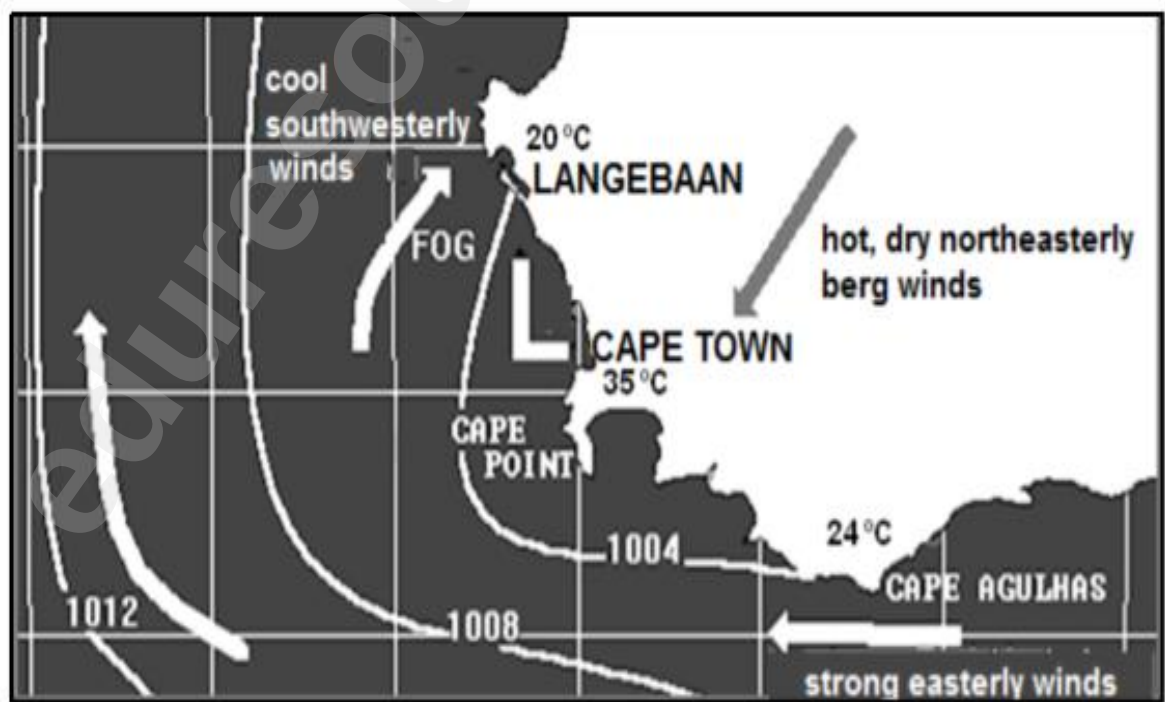


[Adapted from www.wikipedia.org]

FEB/ MARCH 2018

- 2.1 FIGURE 2.1 shows a coastal low pressure cell (L) associated with travelling disturbances.
- 2.1.1 Use the isobars to prove that L is a low-pressure system.
- 2.1.2 Where does low-pressure cell L originate?
- 2.1.3 In which direction does low-pressure cell L travel between Langebaan and Cape Town?
- 2.1.4 What type of precipitation is associated with low-pressure cell L along the West Coast?
- 2.1.5 Name the air temperature associated with the onshore flow of low-pressure cell L at Langebaan.
- 2.1.6 How does air rotate around low-pressure cell L?
- 2.1.7 With which travelling disturbance is the hot, dry north-easterly wind associated? (7 x 1) (7)

FIGURE 2.1: A COASTAL LOW PRESSURE SYSTEM



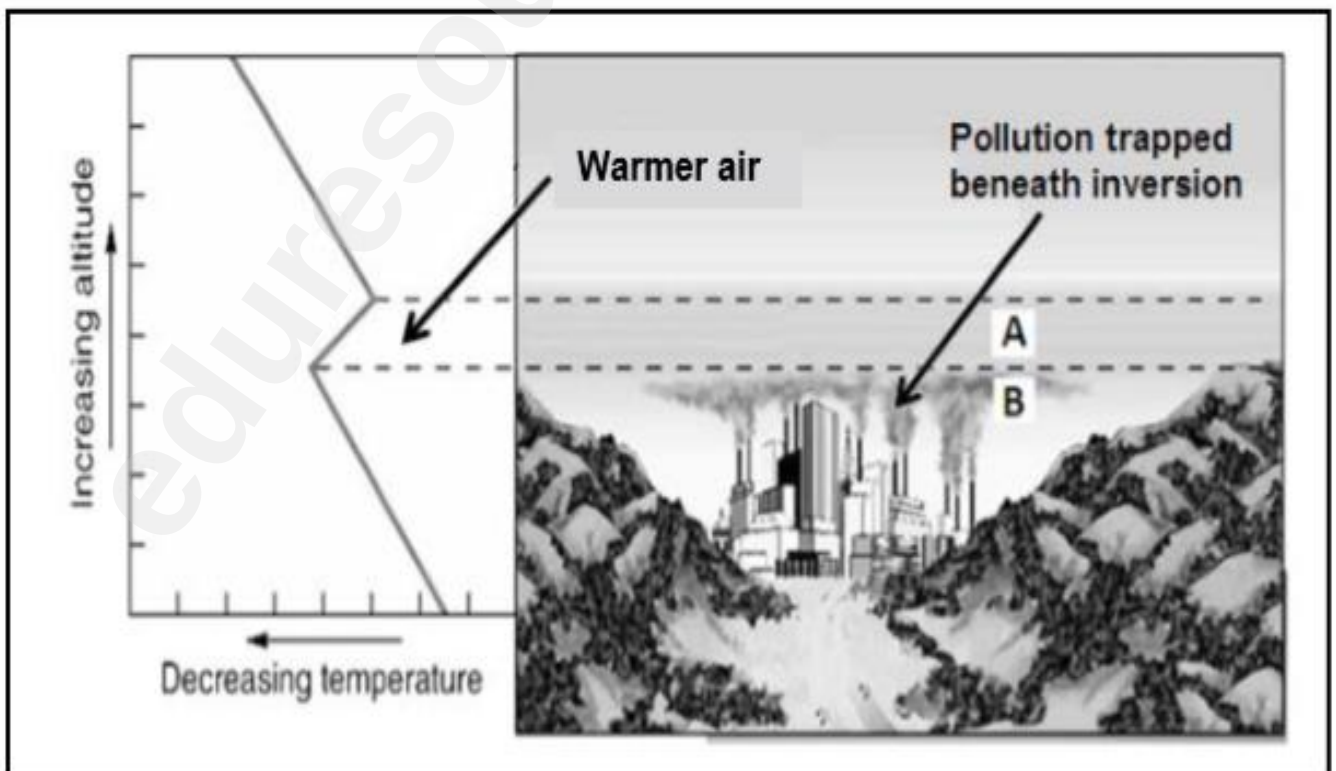
[Source: South African Weather Service]

MAY/ JUNE 2016

1.4 FIGURE 1.4 shows a temperature inversion in a valley.

- 1.4.1 Identify the cause of air pollution in this valley. (1 x 1) (1)
- 1.4.2 Name ONE example of a type of pollutant that is emitted at point **B**. (1 x 1) (1)
- 1.4.3 Give a suitable term to describe area **A**. (1 x 1) (1)
- 1.4.4 Describe the relationship between altitude and temperature as shown on the graph. (1 x 2) (2)
- 1.4.5 The amount of smoke on the valley floor could increase at night. Suggest TWO possible reasons for this increase. (2 x 2) (4)
- 1.4.6 Analyse the following statement: 'Temperature influences the location of settlements in a valley.' (3 x 2) (6)

FIGURE 1.4: TEMPERATURE INVERSION IN A VALLEY



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

VALLEY CLIMATES

- **ASPECT** - the direction in which the slope faces.
- **IN THE SOUTHERN HEMISPHERE** - people choose the North facing slope, this is because that is the warmer side and it receives direct sun's rays.
- **MIDDLE OF THE SLOPE** - these are also preferred because they are warm and receive direct sun's rays.



TWO TYPES OF WINDS:

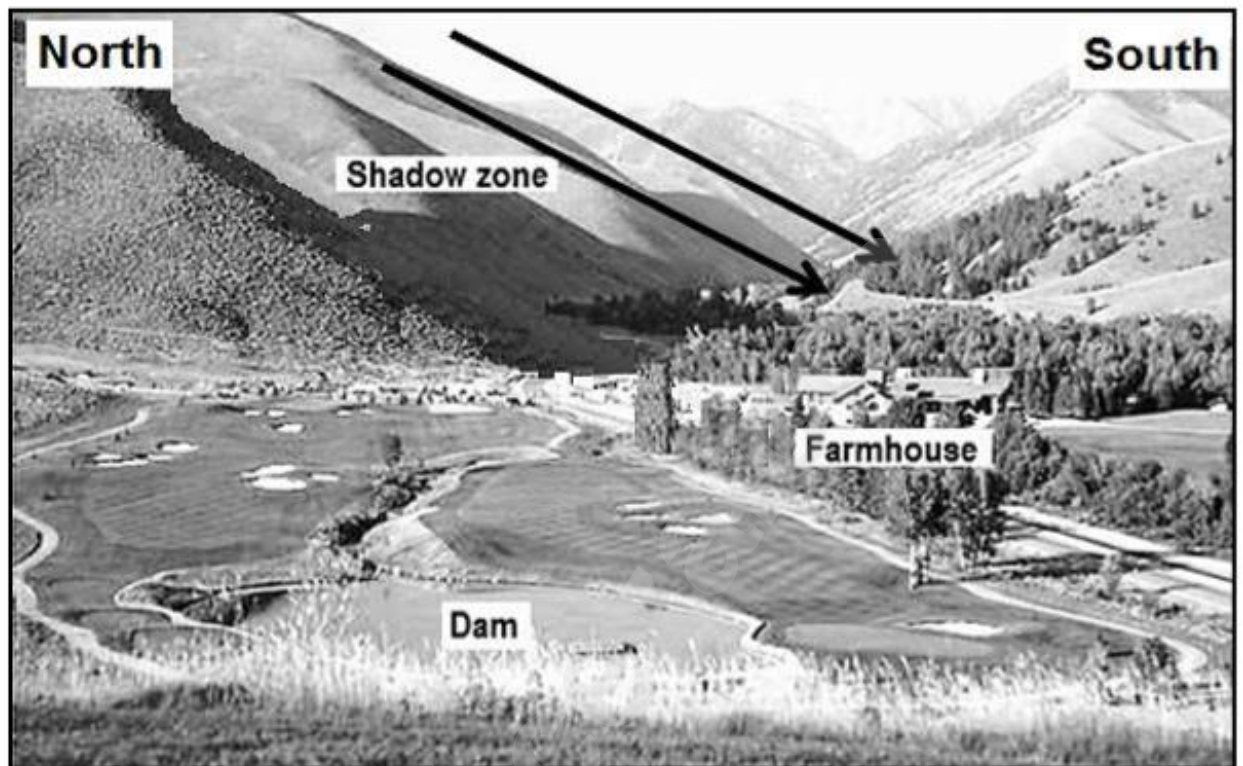
- **ANABATIC WINDS** - these are;
 - ✓ Winds that blow up the valley slopes during the DAY.
 - ✓ WARM and they RISE.
 - ✓ Less dense and moist.
- **KATABATIC WINDS** - these are;
 - ✓ Winds that blow down the slope during the NIGHT.
 - ✓ COLD and they SINK.
 - ✓ More dense and dry.

QUESTIONS ON VALLEY CLIMATES

NOVEMBER 2016

- 2.3 Study FIGURE 2.3, which shows the influence of slope aspect in a valley in the Southern Hemisphere (30°S).
- 2.3.1 Define the term *slope aspect*. (1 x 1) (1)
- 2.3.2 Which slope in FIGURE 2.3 receives direct rays of the sun? (1 x 1) (1)
- 2.3.3 Refer to the slope labelled 'shadow zone' in the picture.
- (a) Give a reason for the high moisture content of the soil on this slope. (1 x 2) (2)
- (b) Why is there a lack of human activity in the shadow zone, despite the high soil moisture content? (1 x 2) (2)
- 2.3.4 Give a possible reason for the location of the farmhouse on the valley floor. (1 x 2) (2)
- 2.3.5 In a paragraph of approximately EIGHT lines, explain, from a climatic point of view, why the location of the farmhouse and the surrounding farmland on the valley floor is not necessarily ideal. (4 x 2) (8)

FIGURE 2.3: A VALLEY IN THE SOUTHERN HEMISPHERE (30°S)



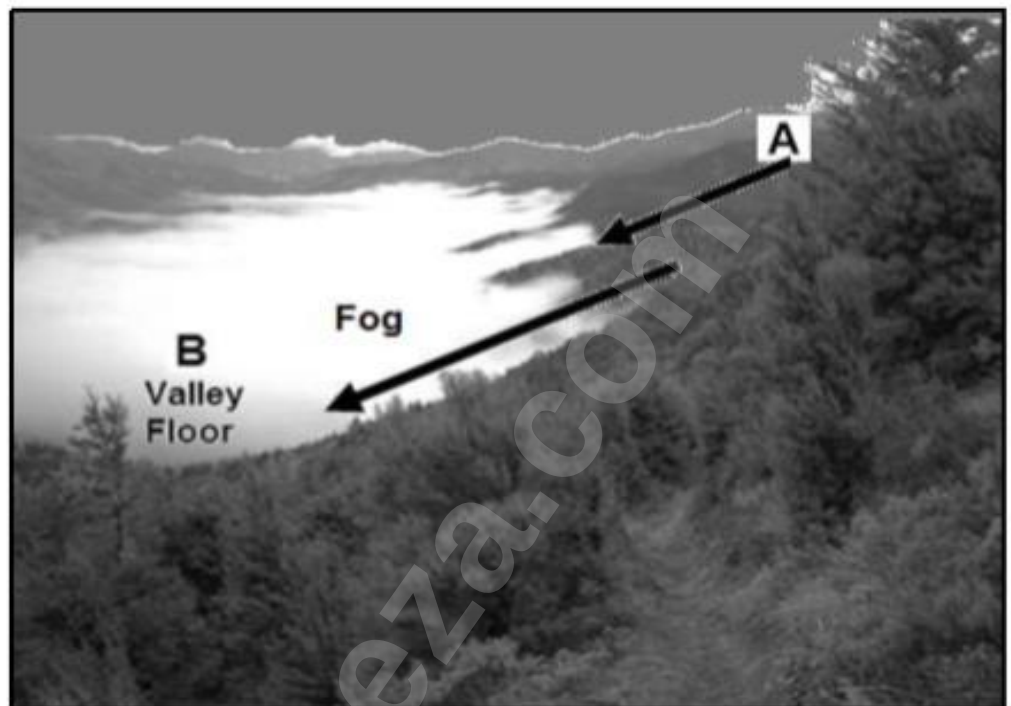
[Adapted from www.classicjetcharters.com]

FEB/ MARCH 2018

1.4 FIGURE 1.4 shows a katabatic wind within a valley.

- | | | | |
|-------|---|---------|-----|
| 1.4.1 | Does this wind occur during the day or at night? | (1 x 1) | (1) |
| 1.4.2 | What role does terrestrial radiation play in the formation of katabatic winds? | (1 x 2) | (2) |
| 1.4.3 | Why are katabatic winds associated with temperature inversions? | (2 x 2) | (4) |
| 1.4.4 | Account for the position of radiation fog in the valley. | (2 x 2) | (4) |
| 1.4.5 | With reference to the photograph in FIGURE 1.4, explain why a developer is more likely to build a holiday resort halfway up the valley slope. | (2 x 2) | (4) |

FIGURE 1.4: A KATABATIC WIND



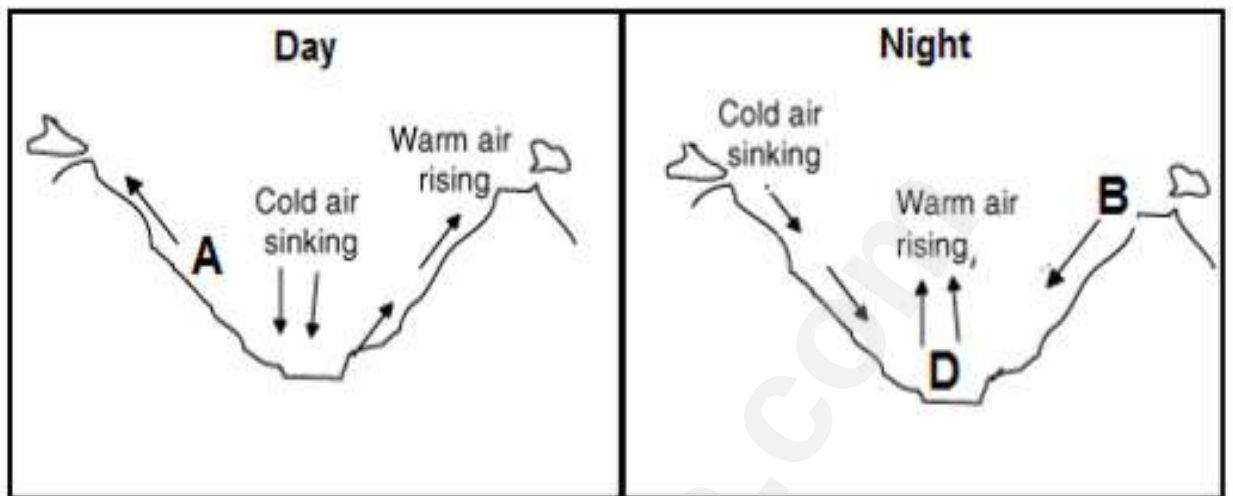
[Source: <http://fox41blogs.typepad.com/.a/6a0148c78b79ee970c019affe51c3d970c-500wi>]

MAY / JUNE 2016

2.3 Study FIGURE 2.3 showing slope winds.

- | | | | |
|-------|--|---------|-----|
| 2.3.1 | Name wind A and wind B . | (2 x 1) | (2) |
| 2.3.2 | State ONE factor that is responsible for the reversal of wind direction, as shown by winds A and B . | (1 x 1) | (1) |
| 2.3.3 | Apart from air movement, state TWO other differences between winds A and B . | (2 x 2) | (4) |
| 2.3.4 | Give a reason why temperature increases with height in valley D . | (1 x 2) | (2) |
| 2.3.5 | Evaluate how the slope winds (A and B) can have both a positive and negative influence on humans and human activities. | (3 x 2) | (6) |

FIGURE 2.3: SLOPE WINDS



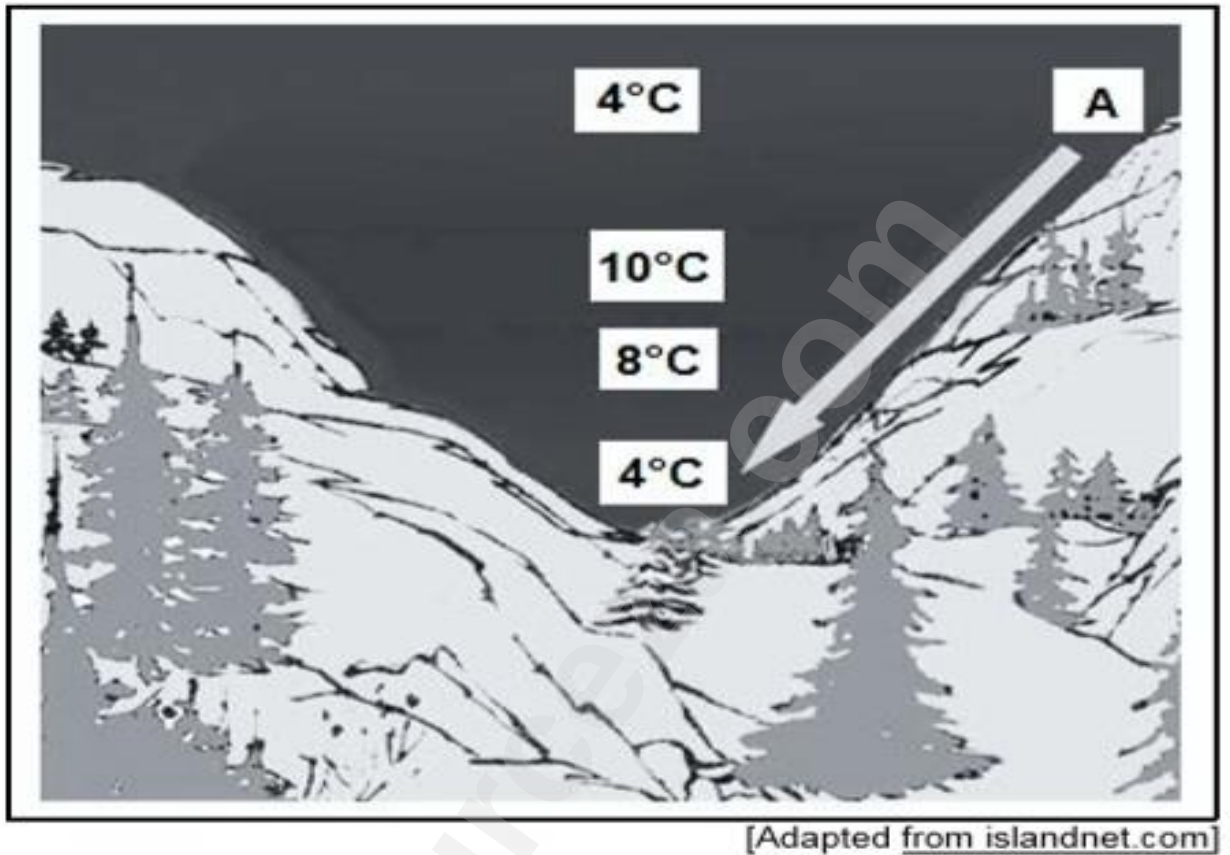
[Source: Examiner's own sketch]

MAY / JUNE 2017

2.3 Study FIGURE 2.3 showing slope winds.

- 2.3.1 Name slope wind **A**. (1 x 1) (1)
- 2.3.2 State ONE factor that is responsible for the movement of slope wind **A**, as shown in FIGURE 2.3. (1 x 1) (1)
- 2.3.3 What impact do the uneven slopes have on the air moving downslope? (1 x 2) (2)
- 2.3.4 Explain why a temperature inversion occurs in a valley at night. (2 x 2) (4)
- 2.3.5 In a paragraph of approximately EIGHT lines, discuss how slope wind **A** can have both a positive and negative influence on vegetation growth on the valley floor. (4 x 2) (8)

FIGURE 2.3: SLOPE WINDS



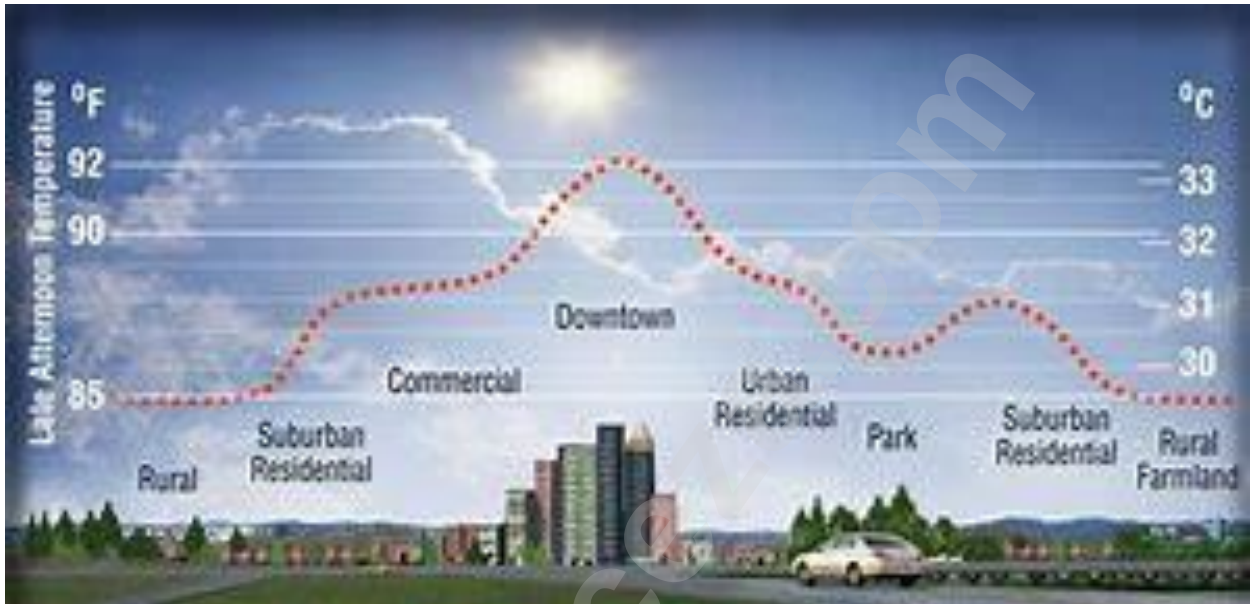
URBAN/CITY CLIMATES

THE DIFFERENCE BETWEEN URBAN AND RURAL CLIMATES

ELEMENT	RURAL	URBAN
TEMPERATURE	These are COLDER, due to the fact that there are very little artificial surfaces here.	These are WARMER, due to the fact that there are a lot of artificial surfaces and human activities (economical activities).
WIND SPEED	More wind speeds in these areas, because there is nothing blocking or deflecting them.	Less wind speeds in these areas, because there are a lot of tall buildings that deflect wind and act as wind breakers.
HUMIDITY	High quantities, because there is a lot of vegetation and open water sources. There is a lot of open space.	Less quantities, because is very little vegetation, less water sources and very little open space.
CLOUDS AND PRECIPITATION	Less clouds and precipitation, due to less artificial surfaces to promote evaporation.	More clouds and precipitation, due to more artificial surfaces to promote evaporation and condensation that leads to precipitation.
SUNSHINE	More sunshine, due to less obstruction. There are no tall buildings to block the sun.	Less sunshine, due to more obstruction from tall buildings in the city.
FOG AND SMOG	Less fog due to low evaporation and less smog due to low pollution rates.	More fog due to more heat from artificial surfaces and more smog due to high rates of pollution.

URBAN HEAT ISLAND

These are higher temperatures in the cities than its surrounding rural areas.



- This phenomenon happens during the DAY.

CAUSES:

- It is hugely influenced by HIGH rate of artificial surfaces in the CBD and its surroundings, respectively.
- Temperatures are higher where there is more artificial surfaces and lower where there is very little artificial surfaces.
- Daily human influxes (incomings) and economical activities also influence this phenomenon in the CBD, making it WARMER.
- Pollution also aids to this phenomenon by trapping heat and making the CBD warmer.
- The heat rises and gets released higher into the atmosphere.

SOLUTIONS:

- Plant more vegetation on surfaces and roof tops.
- Encourage people to use public transport.
- Encourage Industrial Decentralization.
- Amend city policies to encourage FLEXI BUSINESS HOURS.
- Encourage industries to have very tall chimneys that will release the pollution higher in the atmosphere.

POLLUTION DOME

This is the huge mass of pollution that trapped above the city.



STRATEGIES TO REDUCE POLLUTION DOME:

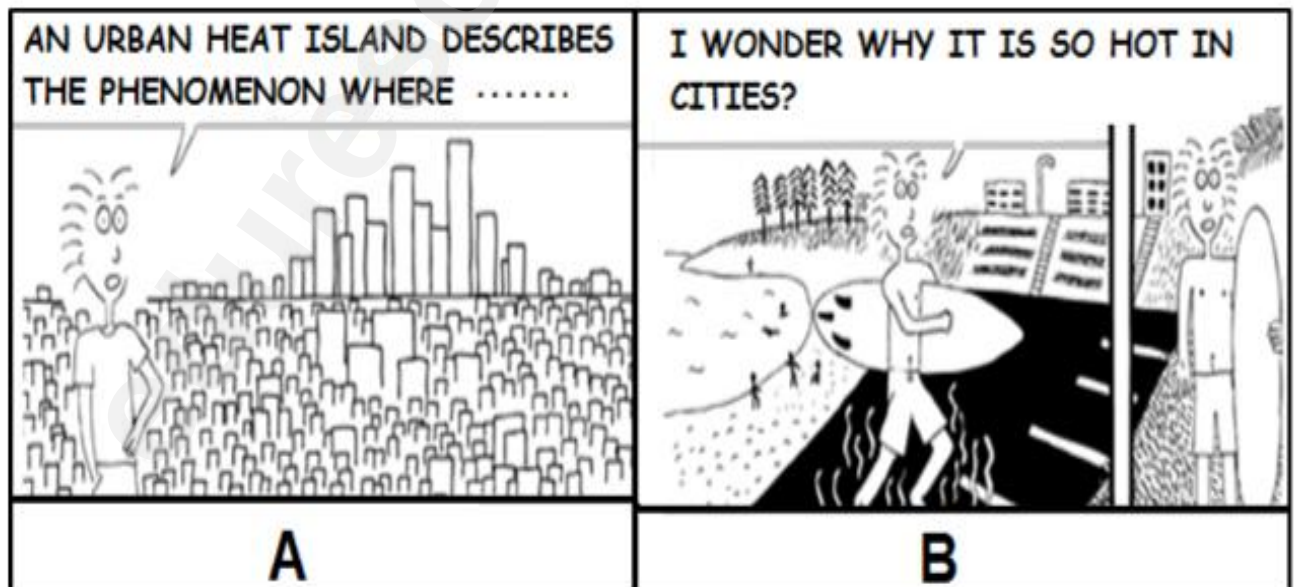
- Introduce GREENBELTS along the city barrier (they absorb carbon dioxide and release oxygen).
- Usage of energy saving strategies like SOLAR PANELS.
- Create more recreational areas in the city.
- Use bright colours to colour buildings and other artificial surfaces.
- Introduce roof gardens and pass them as a law or policy.
- Industrial decentralization.
- Use of public transport.

QUESTIONS ON URBAN HEAT ISLAND

FEB / MARCH 2017

- 1.4 Study FIGURE 1.4 showing a cartoon on an urban heat island.
- 1.4.1 Complete the statement describing an urban heat island in **A**:
An urban heat island describes the phenomenon where ... (1 x 1) (1)
- 1.4.2 Refer to **B** and give TWO reasons for the heat generated in the city.
(2 x 1) (2)
- 1.4.3 What impact will the increased temperatures have on people living in the city?
(2 x 2) (4)
- 1.4.4 In a paragraph of approximately EIGHT lines, provide sustainable methods that can be implemented in an attempt to control the temperature in the city.
(4 x 2) (8)

FIGURE 1.4: URBAN HEAT ISLAND

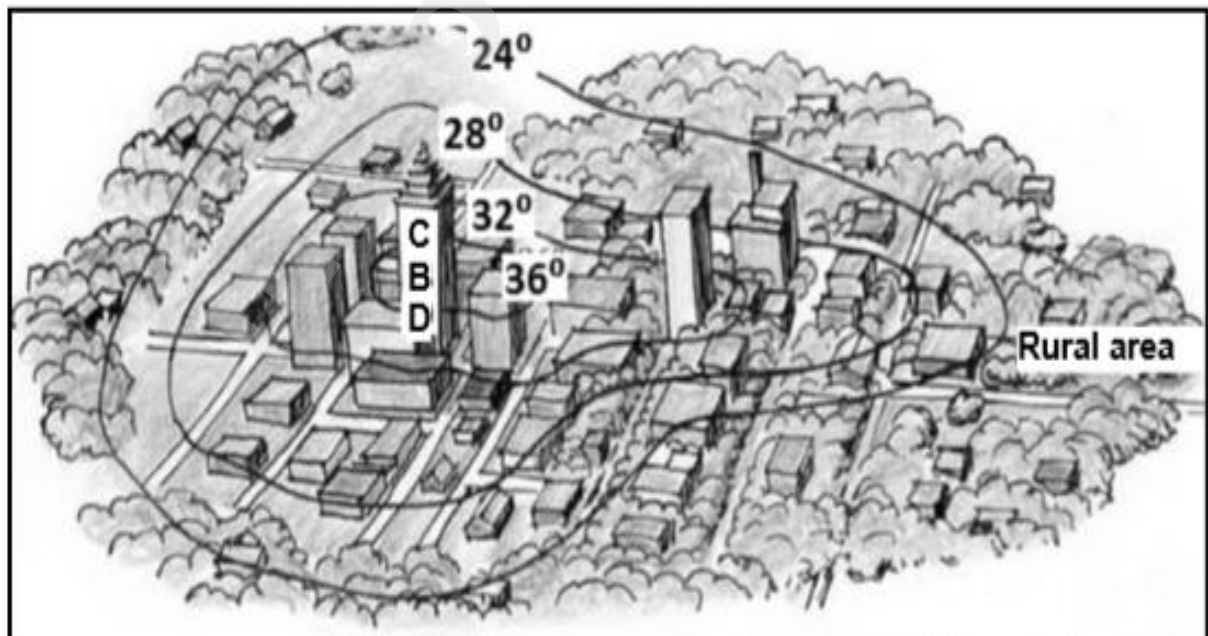


[Adapted from [Stuart McMillencartoons.recombinant.records](http://StuartMcMillencartoons.recombinant.records)]

NOVEMBER 2014

- 2.4 Study FIGURE 2.4 which shows a heat island over a South African city.
- 2.4.1 What is the name given to the lines that show the temperature readings over the city? (1 x 1) (1)
- 2.4.2 What is the temperature difference between the CBD and the rural area? (1 x 2) (2)
- 2.4.3 How do high-rise buildings contribute to the CBD having a higher temperature? (1 x 2) (2)
- 2.4.4 Suggest TWO possible reasons why the temperature lines mentioned in QUESTION 2.4.1 are not circular. (2 x 2) (4)
- 2.4.5 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)

FIGURE 2.4: URBAN HEAT ISLAND

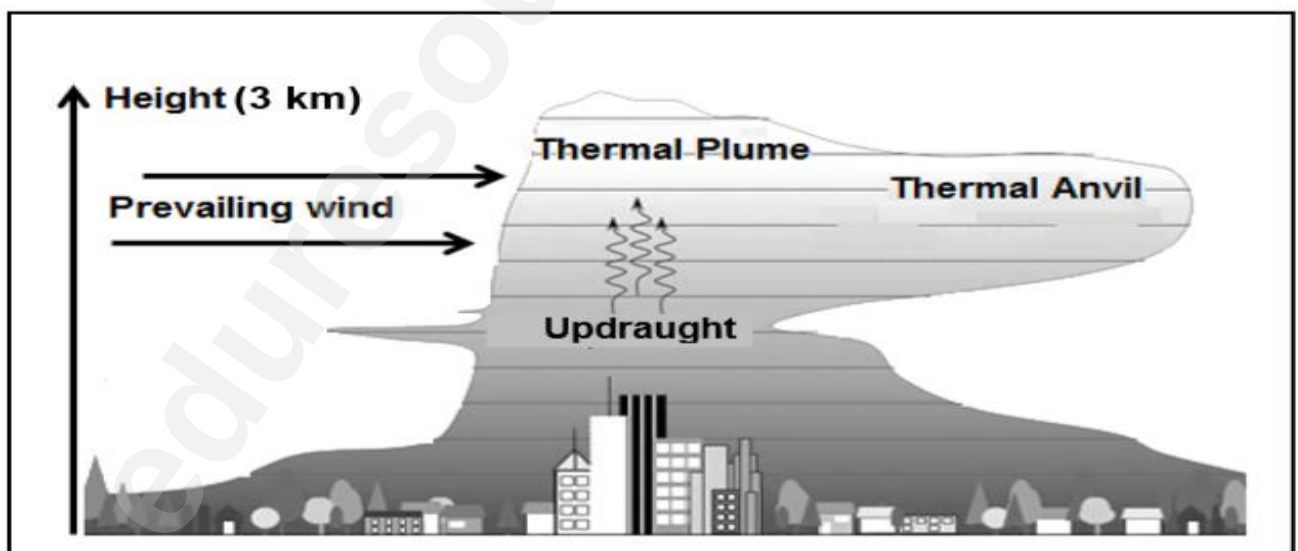


[Source: GSCE Examination Series]

MAY/ JUNE 2016

- 2.4 FIGURE 2.4 is a schematic representation of the dimensions of an urban heat island.
- 2.4.1 Give a possible reason for the asymmetrical (unbalanced) shape of the thermal plume of the urban heat island. (1 x 1) (1)
- 2.4.2 Give TWO points of evidence that suggest that FIGURE 2.4 represents daytime conditions. (2 x 1) (2)
- 2.4.3 Draw a labelled diagram to show changes to the shape of the urban heat island during the night. (2 x 1) (2)
- 2.4.4 State why the area in the city centre (CBD) is associated with stronger updraughts. (1 x 2) (2)
- 2.4.5 In a paragraph of approximately EIGHT lines, explain how the building density of the CBD and building materials used in the CBD cause the formation of the intense (strong) urban heat island. (4 x 2) (8)

FIGURE 2.4: DIMENSIONS OF AN URBAN HEAT ISLAND



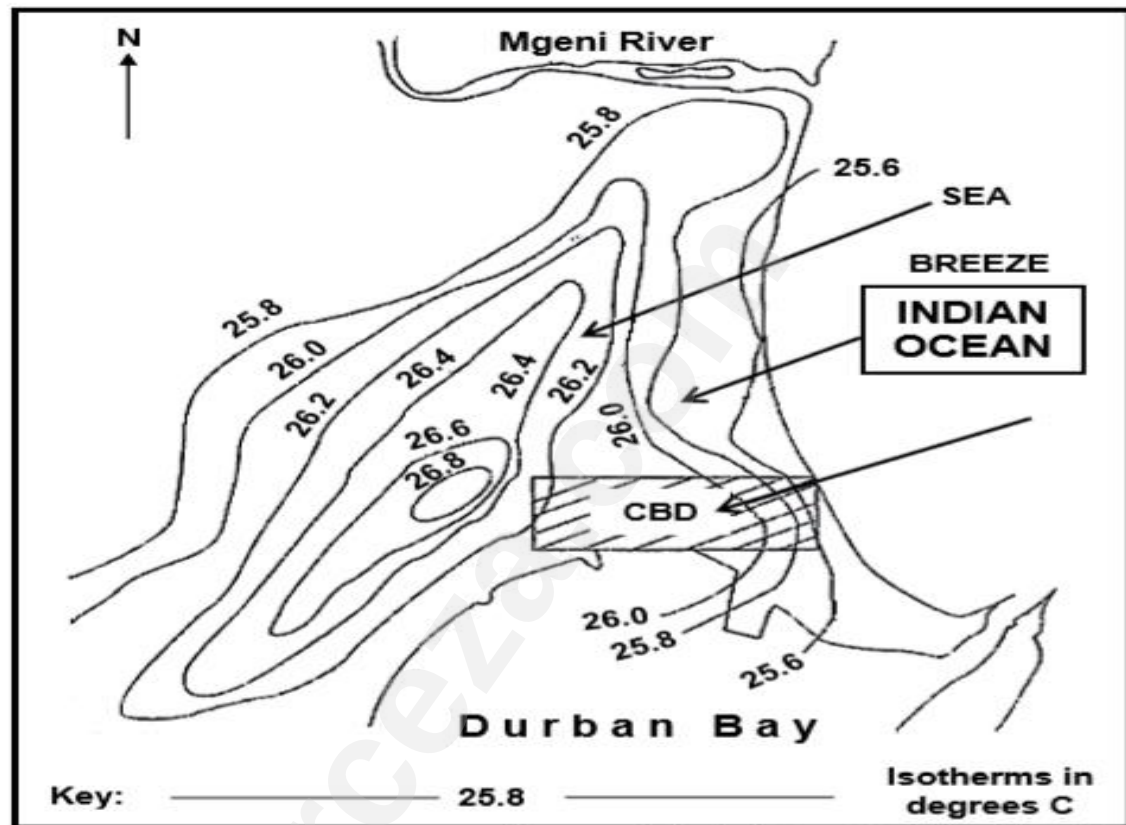
[Adapted from <http://www.asdu.edu.co.za>]

SEPTEMBER 2018 (KWAZULU NATAL)

1.4 Refer to **FIGURE 1.4** showing an urban heat island over Durban.

- 1.4.1 Define the term *urban heat island*. (1 x 1) (1)
- 1.4.2 Why are the highest temperatures not recorded over the CBD of Durban as expected? (1 x 2) (2)
- 1.4.3 Explain how the geometric shapes of the buildings and materials, such as tar, contribute to the high temperatures in the city. (2 x 2) (4)
- 1.4.4 The concentration of pollutants over the CBD is greater during the night as compared to the day.
Draw a fully labelled diagram to illustrate the resultant dust dome with the air circulation over the city at night. (4 x 1) (4)
- 1.4.5 The city authorities are concerned about the high temperatures over the city of Durban. Suggest TWO sustainable measures that can be put in place to reduce the temperatures in the city. (2 x 2) (4)

FIGURE 1.4: URBAN HEAT ISLAND OVER DURBAN



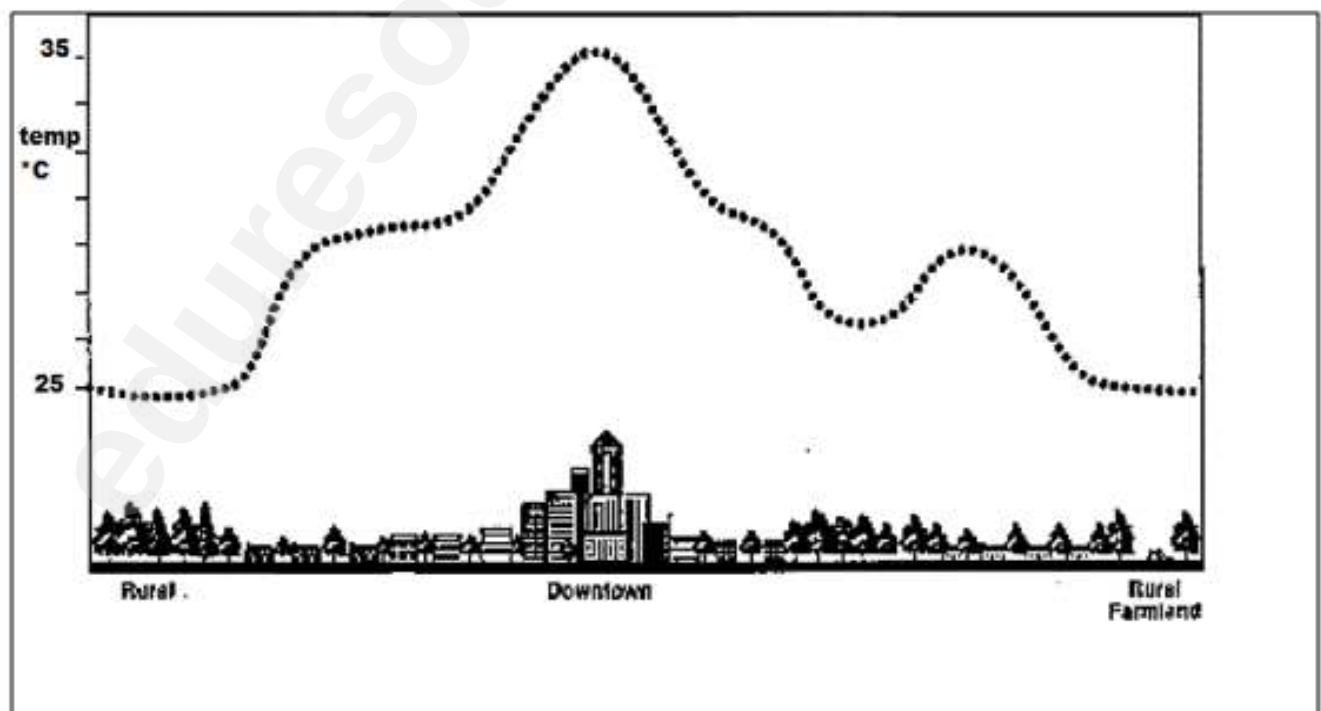
Source: Adapted from Solutions for all

JUNE EXAM 2018 (FREE STATE) FOR FULL TIME LEARNERS

2.4 FIGURE 2.4 shows urban climates.

- 2.4.1 Define the term *heat island*. (1x1) (1)
- 2.4.2 Name TWO climatic factors that contribute to the development of an urban heat island. (1x2) (2)
- 2.4.3 Cities do not experience high temperatures only but also high pollution levels. Account for this statement. (1x2) (2)
- 2.4.4 Draw a diagram with labels to indicate the position and occurrence of the pollution dome over the city and the surrounding rural areas. (2x2) (4)
- 2.4.5 Predict how the consequences of the heat island can interfere with flights at the international airport nearby. (2x2) (4)

FIGURE 2.4 URBAN CLIMATE



GEORMORPHOLOGY

DRAINAGE SYSTEM:

CONCEPTS:

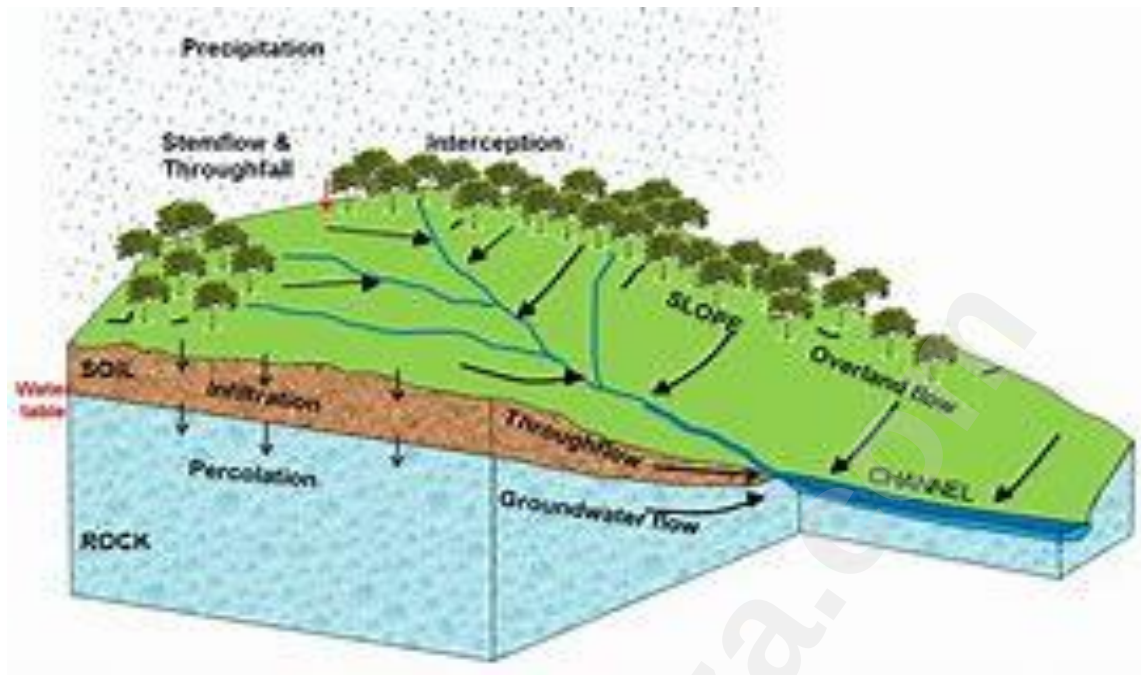
- ✓ **Drainage Basin** – an area drained by a river and its tributaries.
- ✓ **Catchment area** – an area over which rain falls and is caught by the drainage area.
- ✓ **Source** – the area where a river begins.
- ✓ **Mouth** – the area where a river meets/joins the sea.
- ✓ **Watershed** – a high lying area that separates two drainage basins.
- ✓ **Tributary** – temporary short streams that join the main river.
- ✓ **Confluence** – point where the tributary joins the main river.
- ✓ **Interfluve** – ridges of high lying ground between stream channels.
- ✓ **Surface run off** – rain water flowing over the land/ground/surface.
- ✓ **Infiltration** – absorption of water by the soil.
- ✓ **Groundwater** – water found under the ground/surface.
- ✓ **Groundwater flow** – water flowing through underground rocks.
- ✓ **Water table** – the upper level of groundwater.
- ✓ **Base flow** – groundwater that seeps into a river.
- ✓ **Porous** – spaces found in rocks and soil through which water can pass.

DRAINAGE BASIN

This is an area drained by a river system (the main river with its tributaries).

Factors influencing surface run off and infiltration:

- **Relief:** Steep slope - more surface run off and less infiltration.
Gentle slope – more infiltration and less run off.
- **Soil type:** Thin soil – more surface run off and less infiltration.
Thick soil – less surface run off and more infiltration.
- **Rock type:** Impermeable and non-porous – more surface run off and less infiltration.
Permeable and porous – more infiltration and less surface run off.
- **Soil moisture:** Saturated soil/wet soil – more surface run off and less infiltration.
Unsaturated soil/dry soil – less surface run off and more infiltration.
- **Vegetation:** Little/no vegetation – more surface run off and less infiltration.
More vegetation – more infiltration and less surface run off.



MAIN SOURCE OF WATER FOR A DRAINAGE BASIN:

- Rainfall
- Groundwater/Base flow
- Snow

TYPES OF RIVERS:

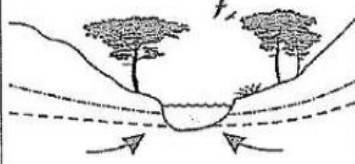
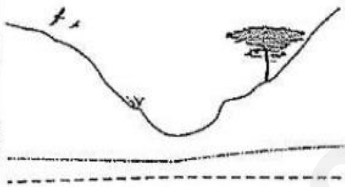
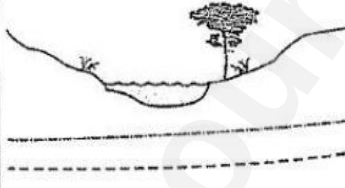
- **PERMANENT:** - flows all year around and associated with high rainfall areas.
- **Periodic/seasonal:** - flows only during the rainy season.
- **Episodic:** - flows only after heavy rainfall or thunderstorms.
- **Exotic:** - originates from areas of high rainfall but flows through dry areas (flows through two different climates).

NB!! – Main rivers are usually permanent rivers.

- Tributaries are usually temporary rivers.

Relationship between the water tables and types of rivers

Schutters:
Pg.155

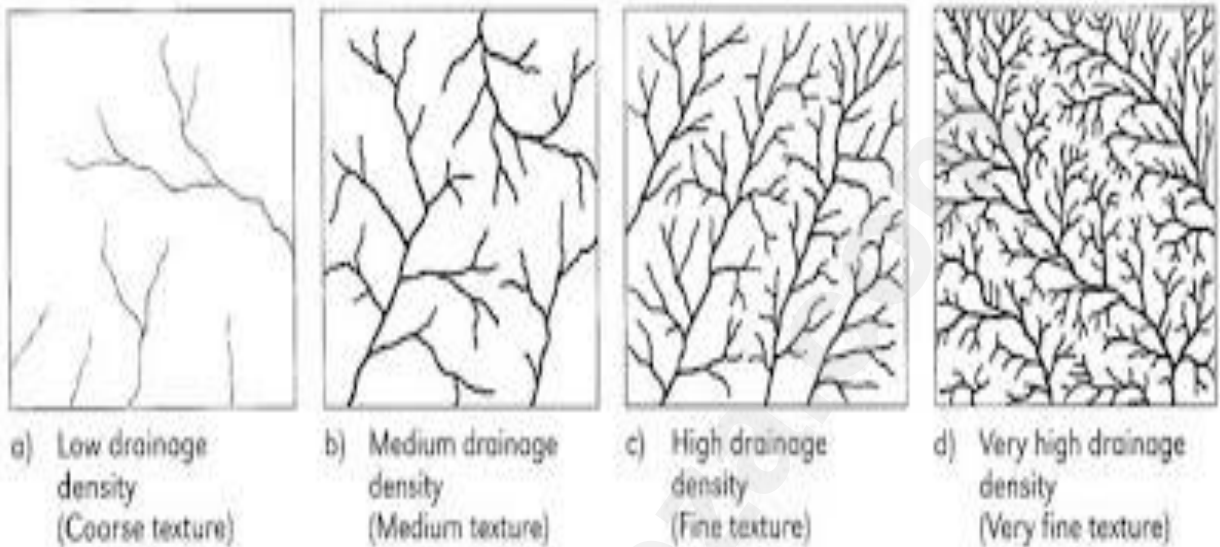
Type	Cross-profile*	Description
Permanent		The river channel intersects both the wet and dry season water table. The river will flow throughout the year. Example - most rivers along the East Coast of SA.
Base flow Underground water seeping into the river. Water table Upper surface of the zone of saturation in the underlying rocks. Wet season The time of year when it normally rains in a particular area. Dry season Season of the year when it does not normally rain in a particular area. Cross-profile The shape of the river channel from bank to bank.		— Wet season water table - - - Dry season water table ➔ Seeping into the ground water channel as base flow
Episodic		The river channel does not intersect either wet or dry season water table and only flows during heavy rains and flash flooding.
Exotic		The river's water source is in a wet area. This supply of water allows the river to flow through drier areas throughout the year. Example - The Gariep River near Upington.

[Orange River](#)

[Rivers](#)

DRAINAGE DENSITY

This is the total length of streams per unit area, normally expressed in kilometres per square kilometre (km/km²).



Factors that influence the drainage density:

- **Climate:** density is usually higher in places that experience wet climates.
- **Rock type:** the more impermeable the rock, the higher the drainage density.
- **Relief:** steeper slopes increase surface run off and as a result there may be fewer channels.
- **Vegetation:** more vegetation results in less drainage density.

2.2 Refer to **FIGURE 2.2** showing the drainage density of two drainage basins of the same size. Indicate whether each of the following descriptions below refers to drainage basin **A** or drainage basin **B**. Write down only the letter **A** or **B** next to the question number (2.2.1 – 2.2.8) in the ANSWER BOOK.

2.2.1 A river that flows over gently sloping land

2.2.2 A drainage basin that experiences high rainfall

2.2.3 A drainage basin that has mainly permeable rock

2.2.4 A drainage basin that has mainly clay soil

2.2.5 A river that flows through hilly areas

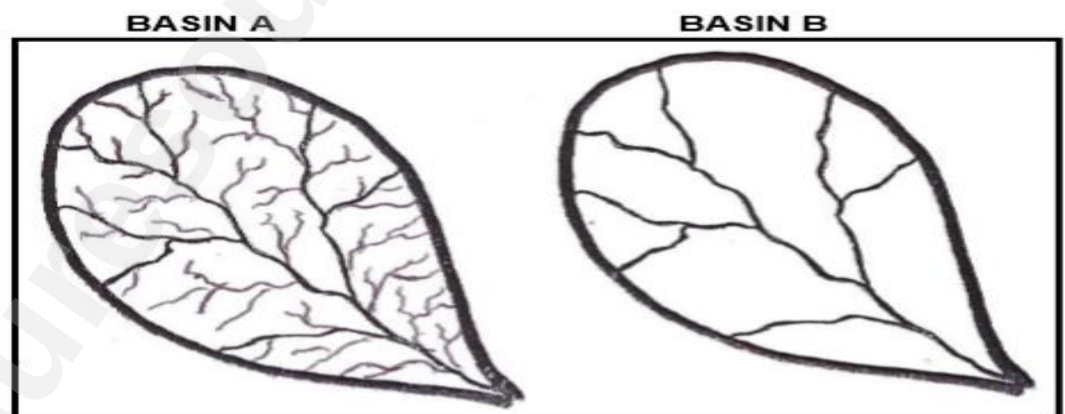
2.2.6 Lush vegetation cover that prevents surface run off

2.2.7 A drainage basin that has porous and sandy soils

2.2.8 A drainage basin in an area with soft continuous rain

(8 x 1) (8)

FIGURE 2.2: DRAINAGE BASINS AND DRAINAGE DENSITY



Source: Adapted from <http://gis4geomorphology.com/wp-content/uploads/03/threshold.jpg>

FREE STATE SEPTEMBER 2019

2.5 Refer to FIGURE 2.5 based on drainage density.

2.5.1 Define the term *drainage density*. (1 x 1) (1)

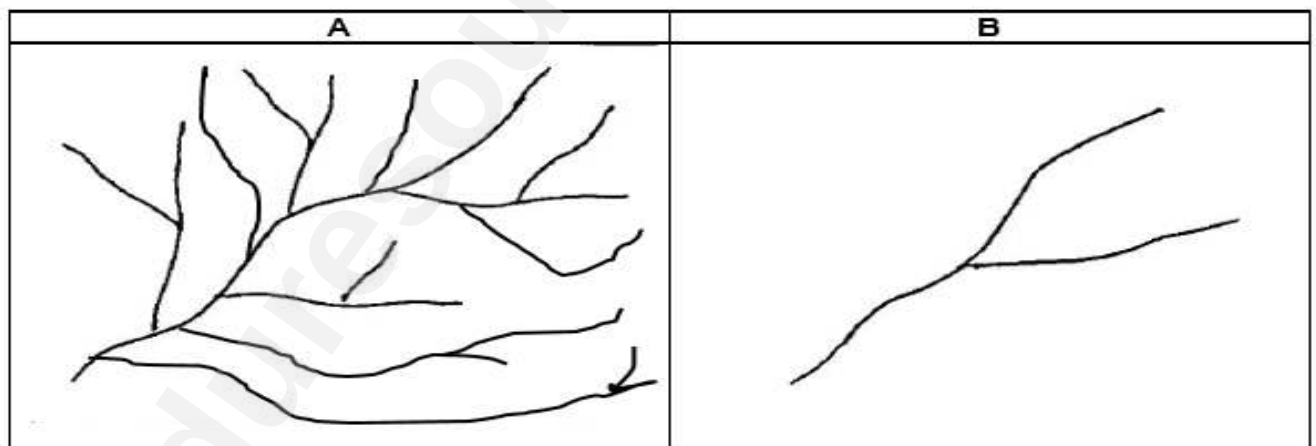
2.5.2 Compare the drainage density between **A** and **B**. (1 x 2) (2)

2.5.3 Describe the resistance of the underlying rock structure at **B**. (1 x 2) (2)

2.5.4 Discuss how slope gradient and rainfall influence drainage density. (2 x 2) (4)

2.5.5 Account for an increase in drainage density as the vegetation is cleared for urban development. (3 x 2) (6)

FIGURE 2.5: DRAINAGE DENSITY

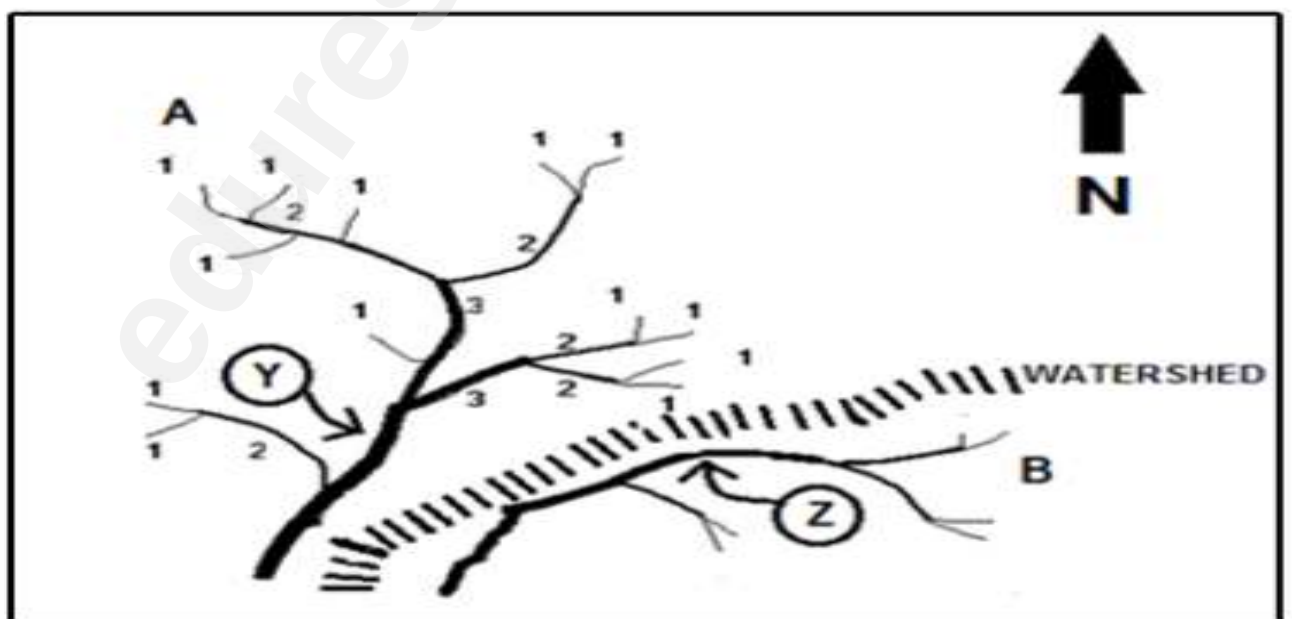


[Source: Examiner's own sketch]

NOVEMBER 2016

- 1.5 Study FIGURE 1.5, which is based on drainage basins.
- 1.5.1 Define the term (1 x 1) (1)
- 1.5.2 Does drainage basin **A** (north of the watershed) or drainage basin **B** (south of the watershed) have the higher drainage density? (1 x 1) (1)
- 1.5.3 State ONE factor that could have contributed to the high drainage density of the drainage basin identified in QUESTION 1.5.2. (1 x 2) (2)
- 1.5.4 Determine the stream order at **Z** in drainage basin **B**. (1 x 2) (2)
- 1.5.5 Refer to drainage basin **A** and state the relationship between stream order and the:
- (a) Length of streams (1 x 2) (2)
- (b) Number of streams (1 x 2) (2)
- 1.5.6 Evaluate the effect of a prolonged period of drought on the stream order at point **Y** in drainage basin **A**. (2 x 2) (4)

FIGURE 1.5: DRAINAGE BASINS



[Source: Examiner's own sketch]

FREE STATE SEPTEMBER 2019

1.2 Study the drainage basin in FIGURE 1.2 and match the letters **A** to **G** to EACH description below.

1.2.1 A second order stream

1.2.2 A single stream that joins the main river

1.2.3 A confluence

1.2.4 An interfluvium

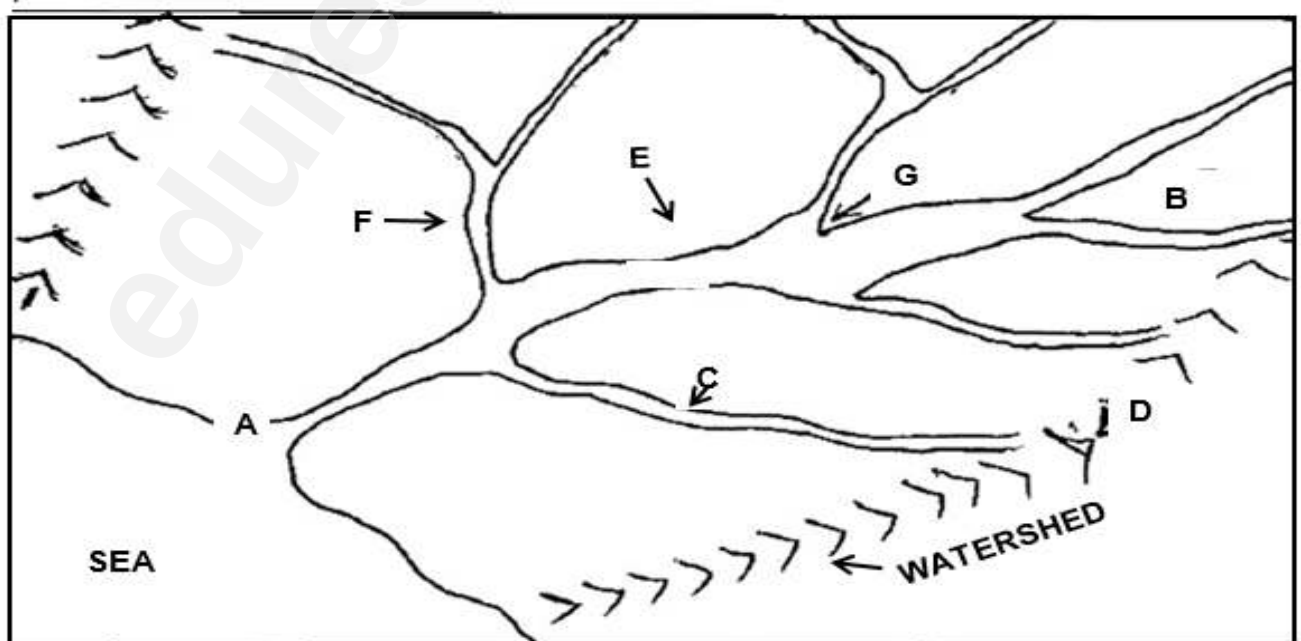
1.2.5 The mouth of a river

1.2.6 The main river

1.2.7 The high lying area separating two drainage basins

(7 x 1) (7)

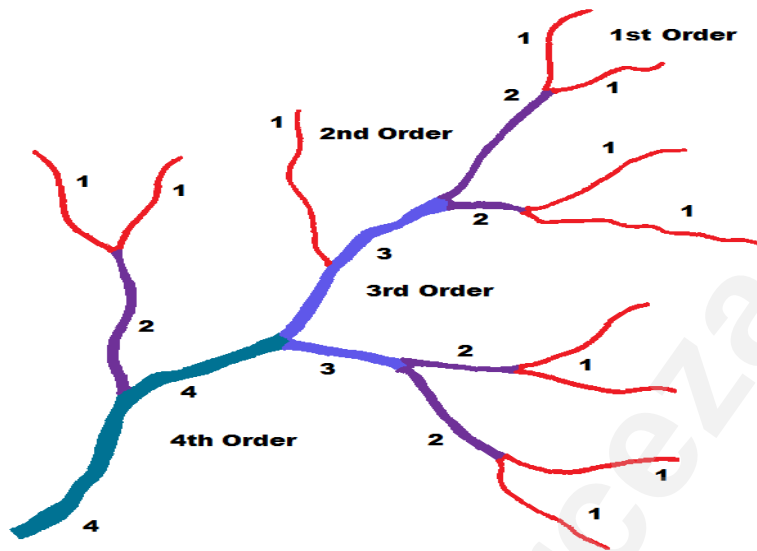
FIGURE 1.2: DRAINAGE BASIN



[Source: Examiner's own sketch]

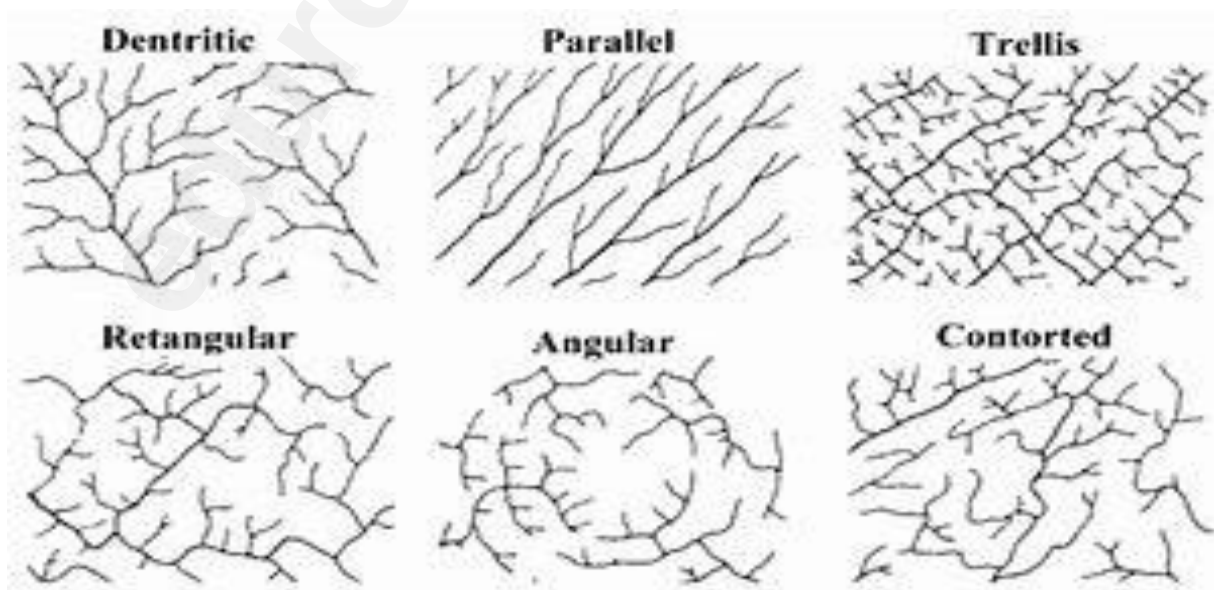
STREAM ORDER

This is a way of classifying streams so that the sizes of the drainage basins can be compared.



DRAINAGE PATTERNS

This refers to the way in which streams are arranged in a drainage basin (the pattern they form).

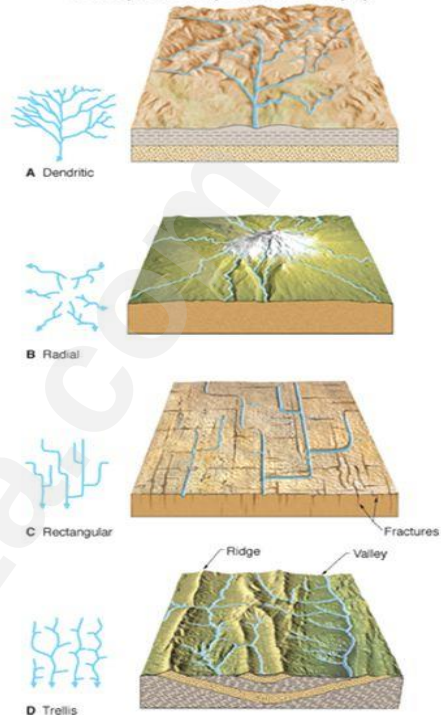


NB!! They are hugely influenced by their underlying rock structures.

Drainage Patterns

- *Drainage pattern* - the arrangement, in map view, of a stream and its tributaries
 - Most tributaries join the main stream at an *acute angle*, forming a V or Y pointing downstream
 - *Dendritic* - drainage pattern resembling the branches of a tree
 - *Radial pattern* - streams diverge outward like the spokes of a wheel
 - Typically form on conical mountains (volcanoes)
 - *Rectangular pattern* - tributaries have frequent 90° bends and join other streams at right angles
 - *Trellis pattern* - parallel streams with short tributaries meeting at right angles

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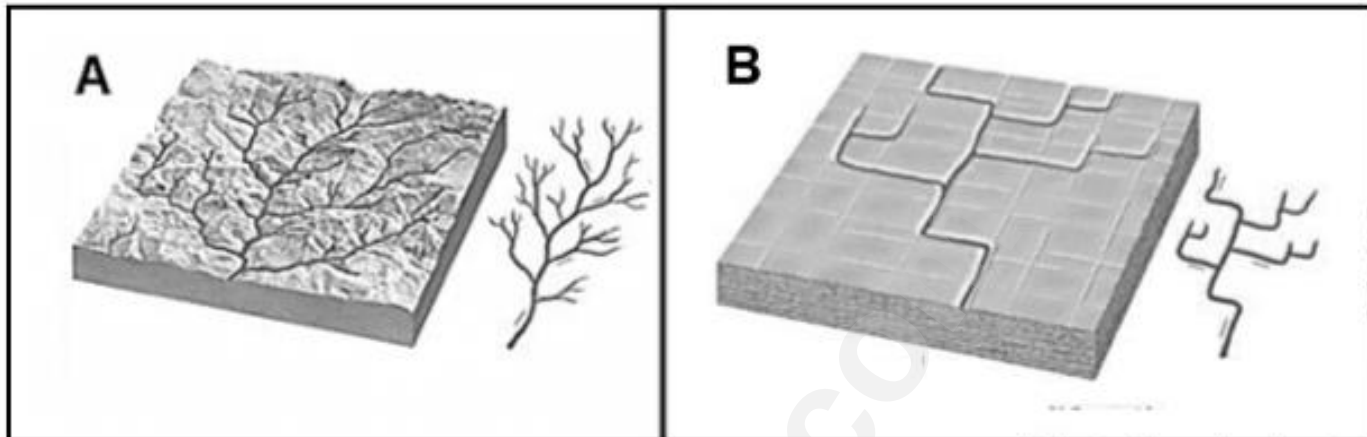


NOVEMBER 2016

2.5 FIGURE 2.5 is a sketch showing two drainage patterns.

- | | | | |
|-------|---|---------|-----|
| 2.5.1 | What is a <i>drainage pattern</i> ? | (1 x 1) | (1) |
| 2.5.2 | Name drainage patterns A and B . | (2 x 1) | (2) |
| 2.5.3 | Give evidence from the diagrams to support your choices in QUESTION 2.5.2. | (2 x 2) | (4) |
| 2.5.4 | Compare the underlying rock structures of drainage patterns A and B in the sketch. | (2 x 2) | (4) |
| 2.5.5 | Draw a simple, labelled plan view sketch of a drainage pattern that will develop in a folded landscape. | (2 x 2) | (4) |

FIGURE 2.5: DRAINAGE PATTERNS

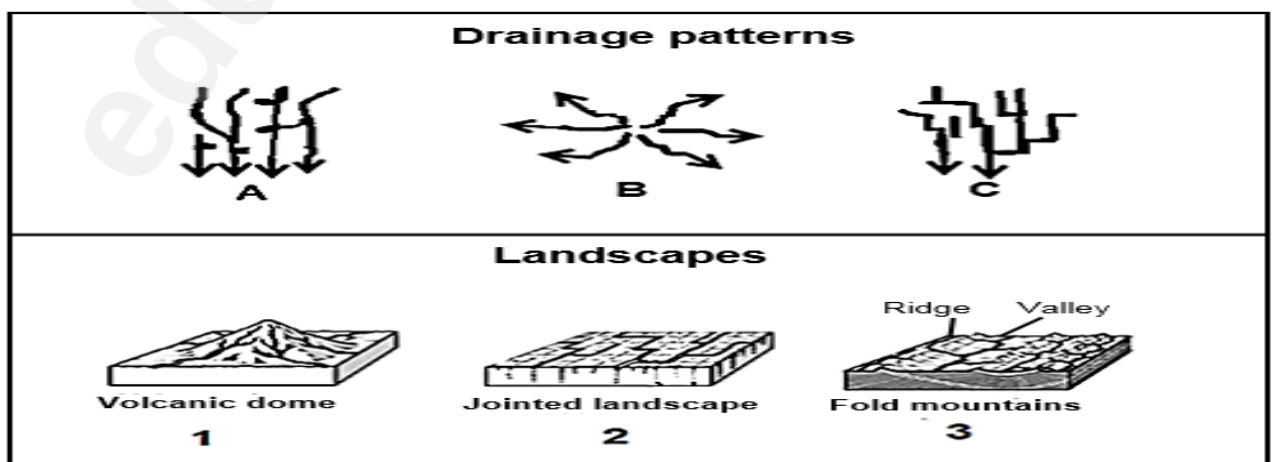


[Adapted from kgs.ku.edu]

NOVEMBER 2015

- 2.6 Study FIGURE 2.6, illustrating drainage patterns and landscapes, and answer the questions that follow.
- 2.6.1 Indicate whether each drainage pattern, **A**, **B** and **C**, refers to landscape **1**, **2** or **3**, on which it is likely to develop. (3 x 1) (3)
- 2.6.2 Name ONE factor that results in different drainage patterns forming. (1 x 2) (2)
- 2.6.3 State ONE characteristic of drainage pattern **B**. (1 x 2) (2)
- 2.6.4 Describe the rock type and underlying structure associated with drainage pattern **C**. (2 x 2) (4)
- 2.6.5 Why do the tributaries in landscape **3** join the main stream at a 90° angle? (2 x 2) (4)

FIGURE 2.6: DRAINAGE PATTERNS AND LANDSCAPES



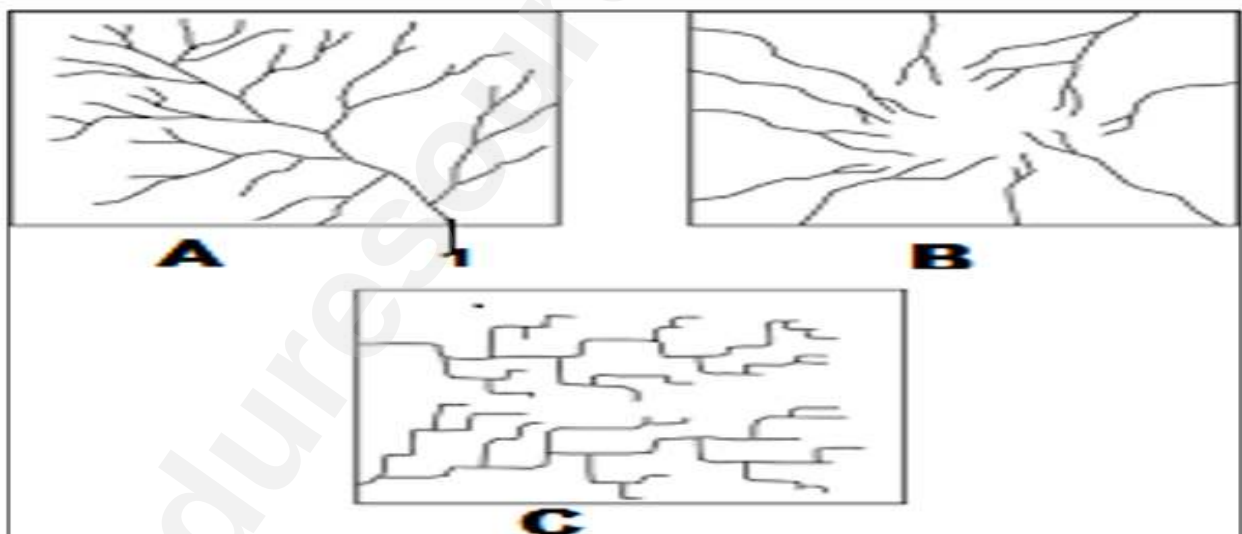
[Adapted from www.landscapes.com]

JUNE 2018

2.5 Refer to FIGURE 2.5 illustrating the different drainage patterns.

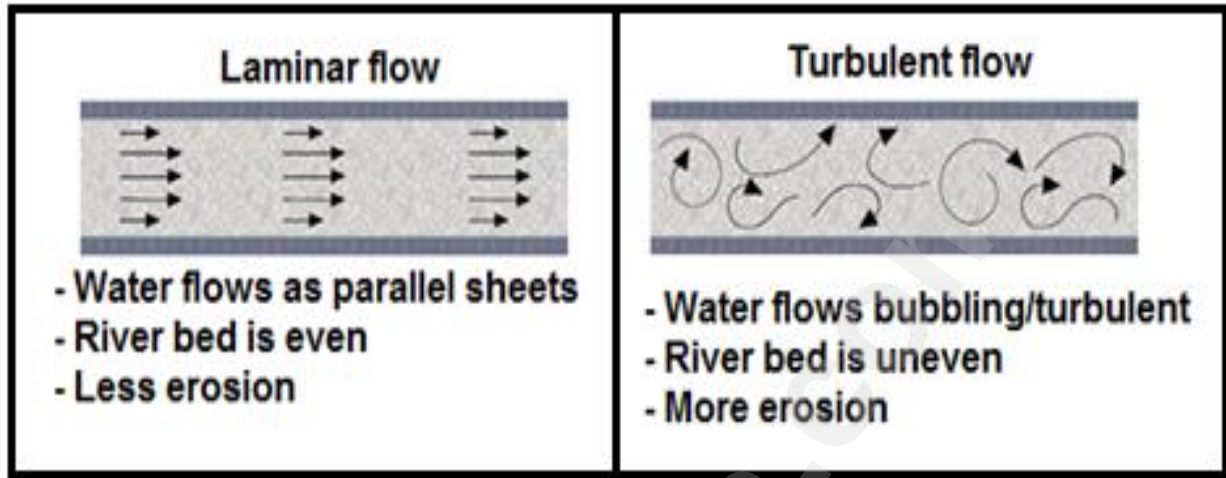
- | | | | |
|-------|---|-------|-----|
| 2.5.1 | Identify the pattern that develops where the main stream makes right angle bends of 90° in its course at C . | (1x1) | (1) |
| 2.5.2 | Identify drainage pattern A and B respectively. | (2x1) | (2) |
| 2.5.3 | Explain ONE factor that could have resulted in a high drainage density at drainage pattern A . | (1x2) | (2) |
| 2.5.4 | Determine the stream order of the drainage pattern A at point 1 on the figure. | (1x2) | (2) |
| 2.5.5 | Describe the formation of drainage pattern B . | (2x2) | (4) |

FIGURE 2.5 DRAINAGE PATTERNS



DISCHARGE OF A RIVER

NB: water in a river flows as laminar flow and turbulent flow.



EROSION BY A RIVER

EROSION OF A CHANNEL CAN BE IN THE FORM OF:

- **HEADWARD EROSION** > is when erosion occurs backward / towards the source of the river. the channel become longer.
- **VERTICAL EROSION** > is when erosion occurs downwards of a river bed. the channel becomes deeper.
- **LATERAL EROSION** > is when erosion occurs sideways of a channel. the channel become wider.

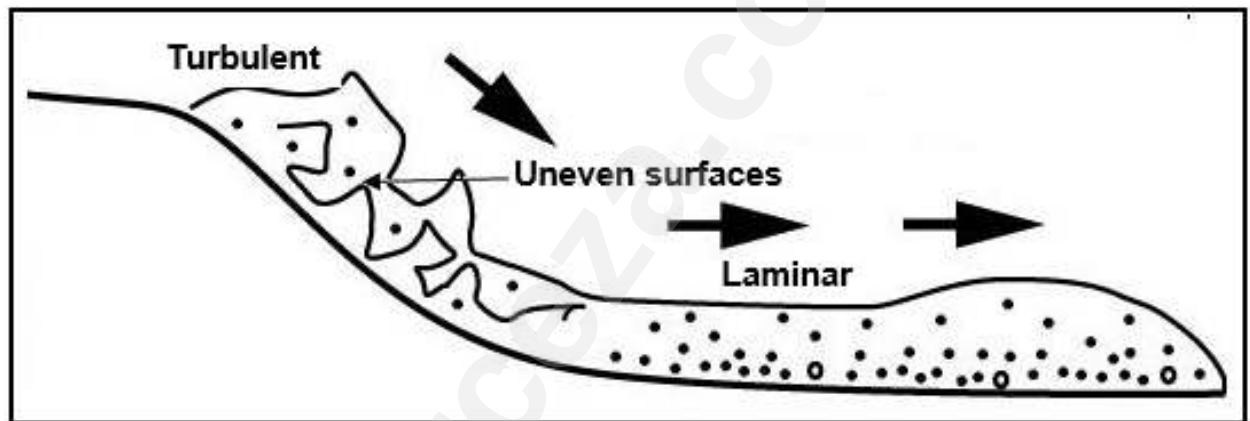
NOVEMBER 2014

2.2 Refer to FIGURE 2.2 showing river flow patterns. Indicate whether each of the following statements refer to turbulent or laminar flow in a river. You may use the same answer for more than one question.

- 2.2.1 Associated with a river bed that is level and even
- 2.2.2 Associated with an irregular and swirling flow
- 2.2.3 Effective in eroding and transporting sediment
- 2.2.4 Commonly occurs in the upper course of a river
- 2.2.5 Water flows in thin layers

- 2.2.6 Associated with a higher river velocity
- 2.2.7 Occurs where rapids are visible in the river's course
- 2.2.8 Has a larger stream load-carrying capacity (8 x 1) (8)

FIGURE 2.2: RIVER FLOW PATTERNS



[Adapted from www.indiaa.edu]

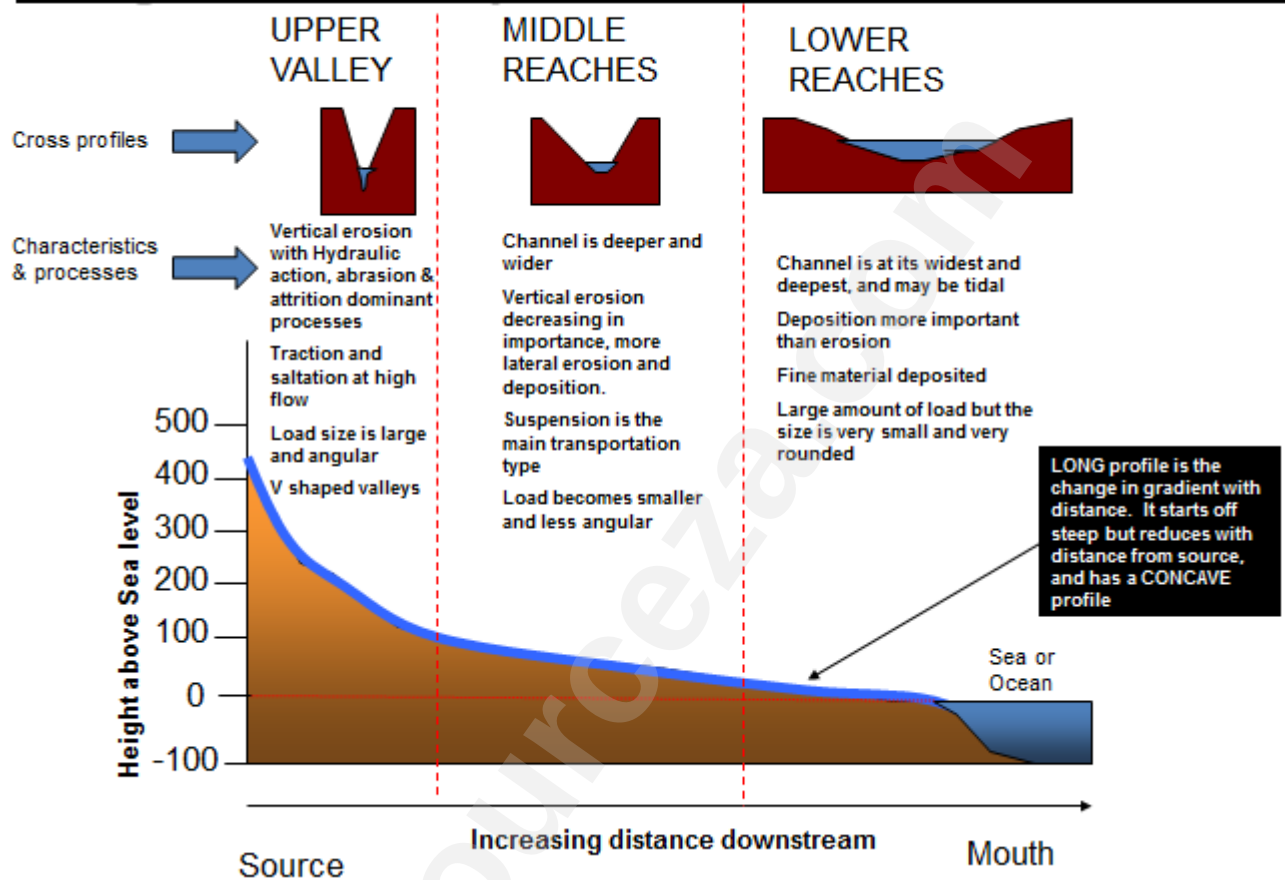
RIVER PROFILES

THERE ARE TWO (2) TYPES OF RIVER PROFILES:

1. **LONGITUDINAL PROFILE** > it shows the length of a river from its source/ upstream (mountain to its mouth/ downstream (sea level).
2. **TRANSVERSE/ CROSS PROFILE** > it shows the shape of the valley across the river valley.

PICTURE OF LONGITUDINAL AND TRANSVERSE PROFILE

Long and cross profiles on a TYPICAL river



TEMPORARY BASE LEVEL > changes in gradient along the course of a river where vertical is slowed down temporarily.

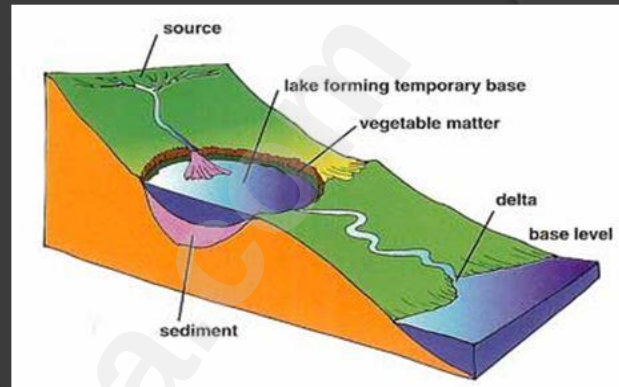
Examples of temporary base levels: rapids, waterfall, lakes and dams.

PERMANENT BASE LEVEL / ULTIMATE BASE LEVEL > the lowest level to which a river will erode its' land (sea land).

PICTURE OF PERMANENT BASE LEVEL AND TEMPORARY BASE LEVEL

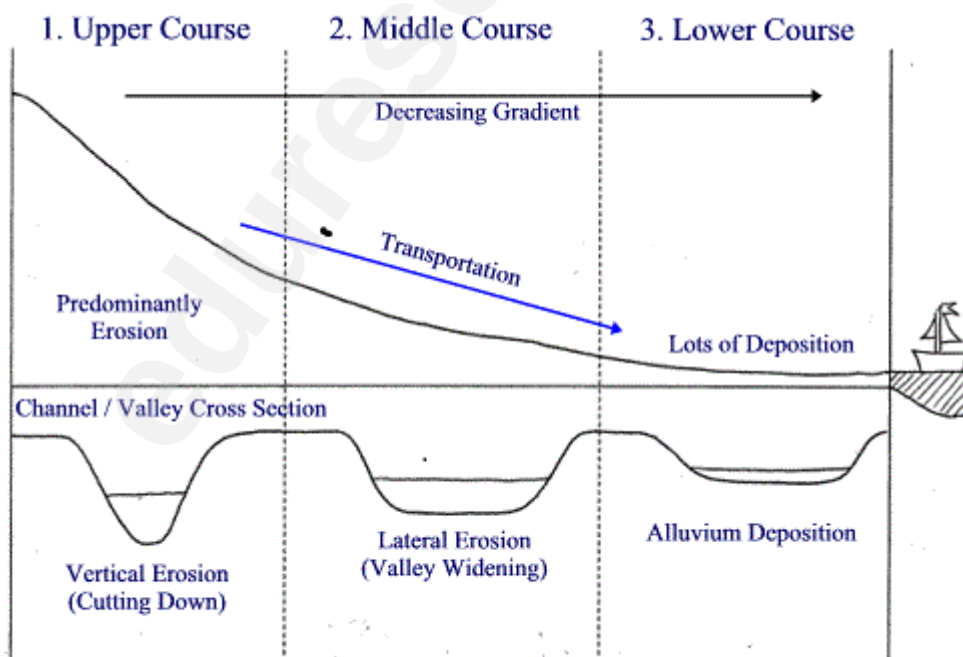
Base Level

- There are two types of base level
 - Ultimate base level
 - Temporary base level
- Sea level is the ultimate base level because it's the lowest level that erosion can lower the land to.
- Temporary base level includes lakes, resistant layers of rock, and main streams that act as base level for their tributaries



When a stream enters a lake, its velocity quickly approaches zero. its ability to erode ceases.

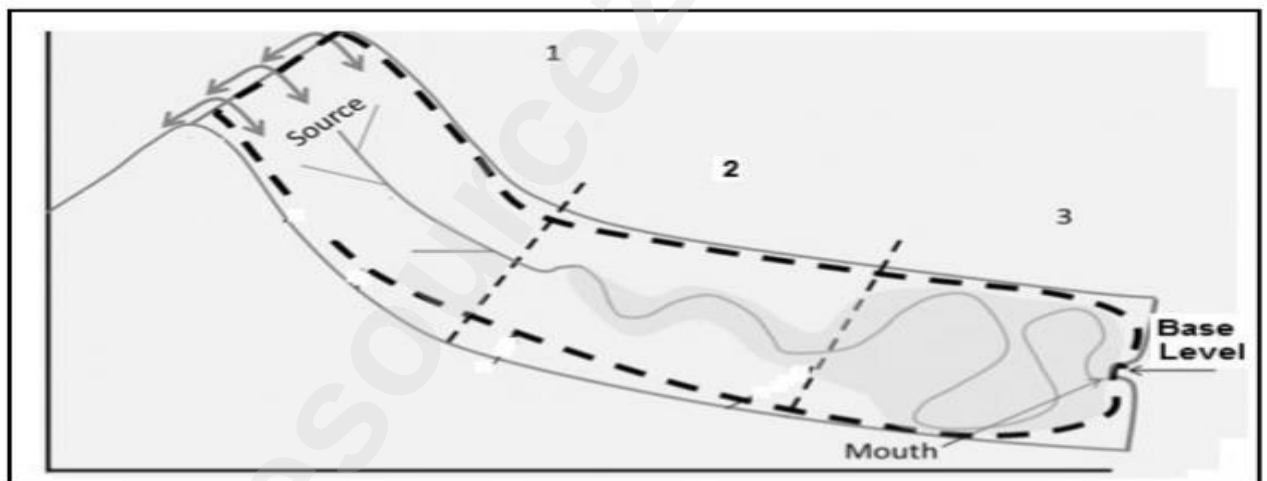
PICTURE OF TRANSVERSE PROFILE ALONG A RIVER COURSE



FEB / MARCH 2018

- 1.6 Study FIGURE 1.6 which shows the longitudinal profile of a graded river.
- 1.6.1 What is meant by the term *base level* of a river? (1 x 1) (1)
- 1.6.2 Why is the sea regarded as a permanent base level? (1 x 2) (2)
- 1.6.3 What evidence in FIGURE 1.6 indicates that this river is graded? (1 x 2) (2)
- 1.6.4 Why will a drop in sea level change the grading of the river? (2 x 2) (4)
- 1.6.5 Draw a simple longitudinal profile to show the impact of the drop in sea level, mentioned in QUESTION 1.6.4, on the shape of the longitudinal profile. (1 x 2) (2)
- 1.6.6 Explain how the interaction between erosion and deposition in the upper and lower courses of a river help to maintain a graded profile. (2 x 2) (4)

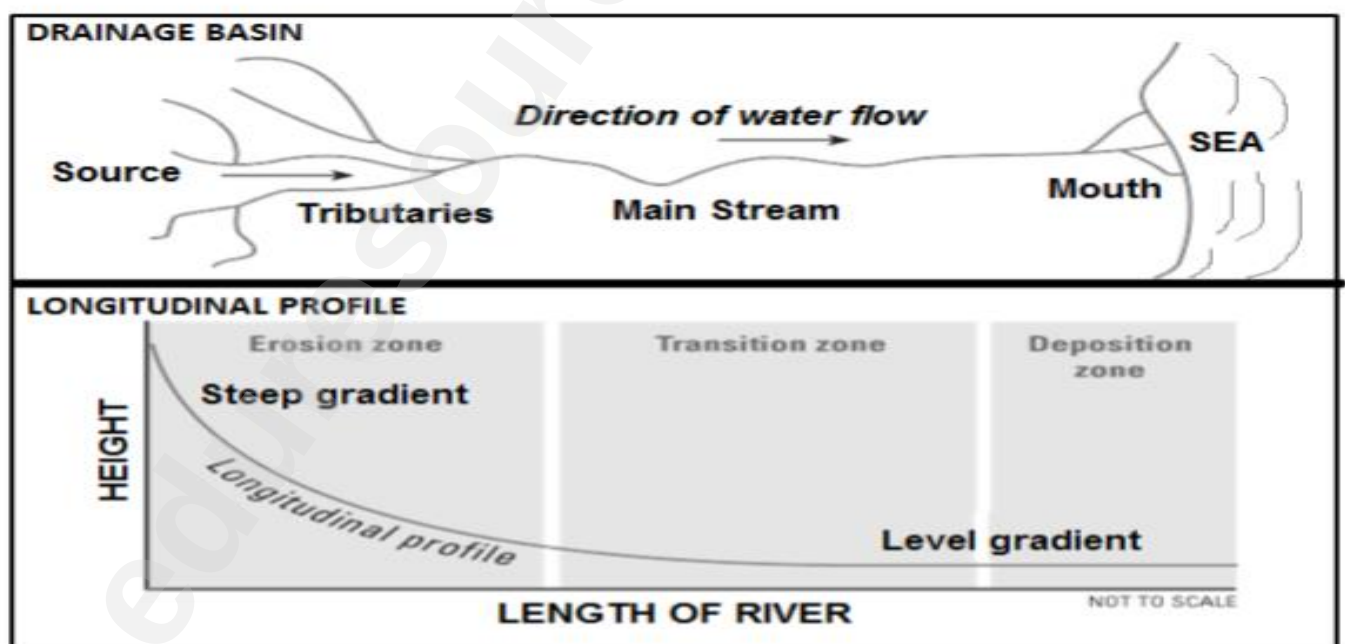
FIGURE 1.6: LONGITUDINAL PROFILE OF A GRADED RIVER



[Adapted from Yorkshiredalesrivertrust.com]

- 2.5 Refer to FIGURE 2.5 which shows a drainage basin from source to mouth and its corresponding longitudinal profile.
- 2.5.1 Define the term *drainage basin*. (1 x 1) (1)
- 2.5.2 The following questions refer to drainage density.
- (a) What is *drainage density*? (1 x 1) (1)
- (b) State ONE factor that influences drainage density. (1 x 2) (2)
- (c) Give evidence from the diagram to indicate that the upper course has the highest drainage density. (1 x 2) (2)
- 2.5.3 The following questions refer to the longitudinal profile.
- (a) What evidence indicates that it is a graded profile? (1 x 1) (1)
- (b) Use FIGURE 2.5 and in a paragraph of approximately EIGHT lines, explain how a river maintains its graded longitudinal profile (the concept of dynamic equilibrium). (4 x 2) (8)

FIGURE 2.5: DRAINAGE BASIN

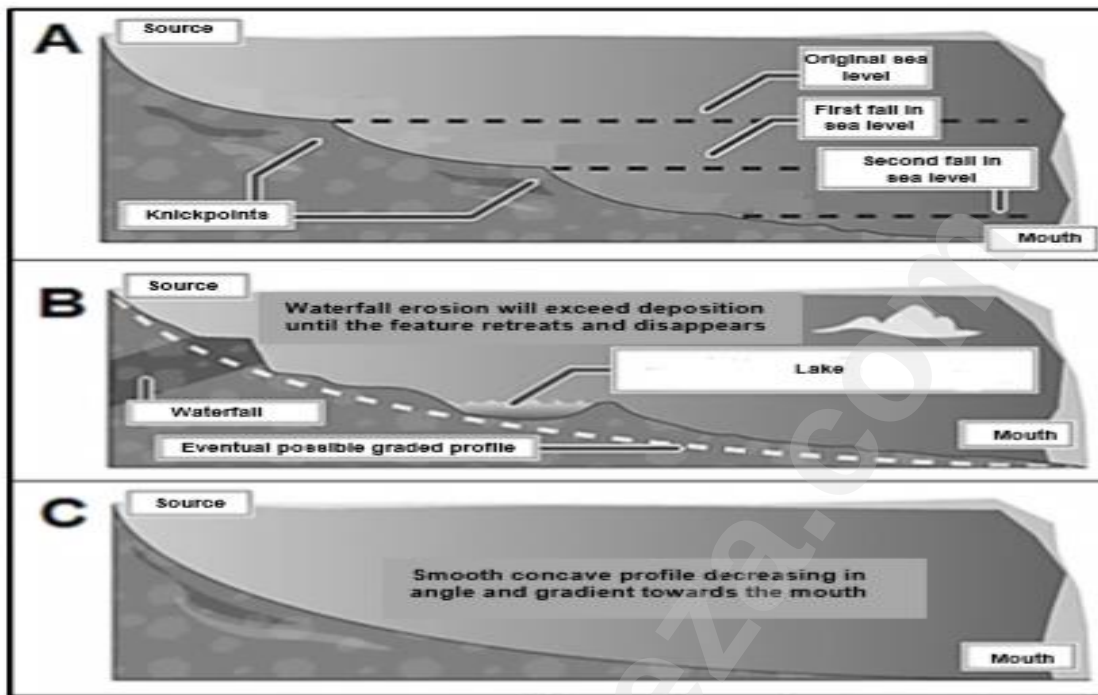


[Adapted from Geography GCSE]

NOVEMBER 2016

- 1.6 Refer to FIGURE 1.6 showing river grade and the longitudinal profiles of a river.
- 1.6.1 Give a geographical term to describe the irregular shape of longitudinal profile **B**. (1 x 1) (1)
- 1.6.2 Name a temporary base level evident in longitudinal profile **B**. (1 x 1) (1)
- 1.6.3 What evidence suggests that rejuvenation has taken place in longitudinal profile **A**? (1 x 2) (2)
- 1.6.4 Describe, with reasons, the changes a river meander will undergo after rejuvenation. (2 x 2) (4)
- 1.6.5 In a paragraph of approximately EIGHT lines, explain the processes that assisted the graded river in profile **C** to have a steep gradient in the upper course and a gradual gradient in the lower course. (4 x 2) (8)

FIGURE 1.6: RIVER GRADE AND LONGITUDINAL PRO



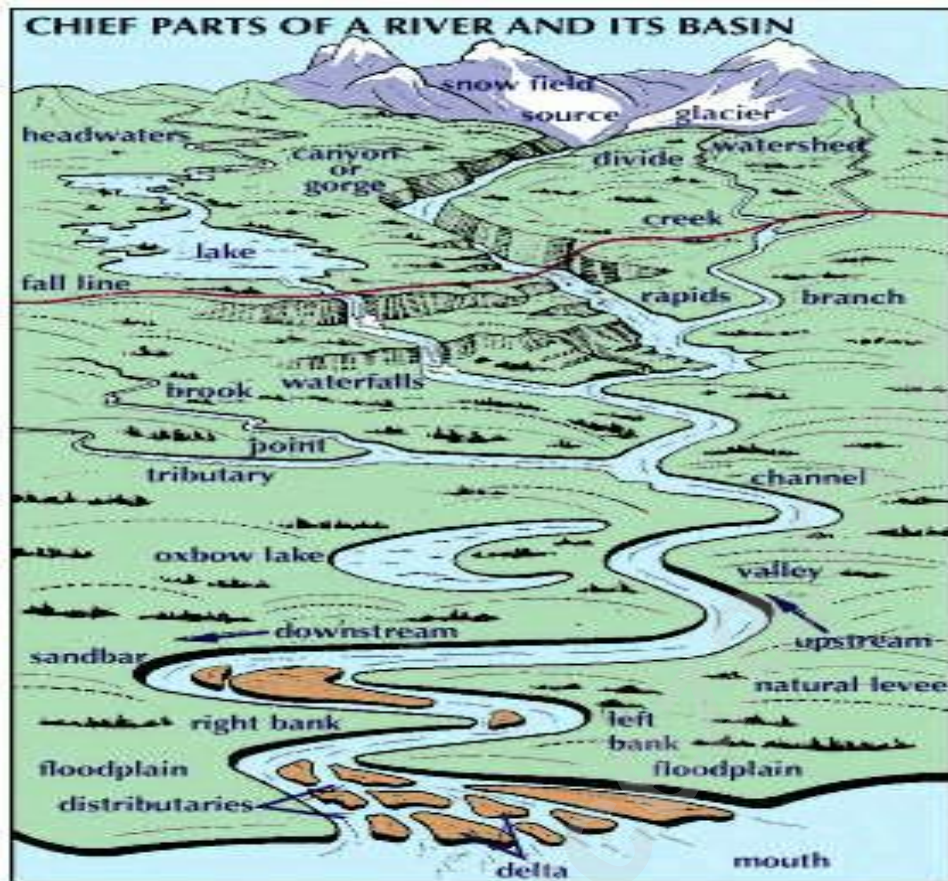
[Adapted from alevelgeography.com]

FLUVIAL LANDFORMS:

1. **LEVEES** > these are raised banks of the river that form when the river floods.
2. **FLOOD PLAINS** > are flat valley floor (fertile soil known as alluvium).
3. **ALLUVIAL FANS** > deposition as the river flows off the mountains on to the flatter plains.
4. **BRAIDED STREAMS** > deposition of alluvium forms an island in the middle of the channel, splitting the river into separate channels.
5. **MEANDERS / MEANDERING CHANNEL** > bends in the river channel.
6. **OXBOW LAKES** > a meander that is cut off when the river takes a new course across the neck of a meander loop.
7. **MEANDER SCARS** > a dried up oxbow lake.
8. **DELTA** > formed when the deposited material builds up and extends into the lake.

PICTURE OF FLUVIAL LANDFORMS





MAY / JUNE 2016

2.6 Along the course of a river, various features such as levees and deltas are found.

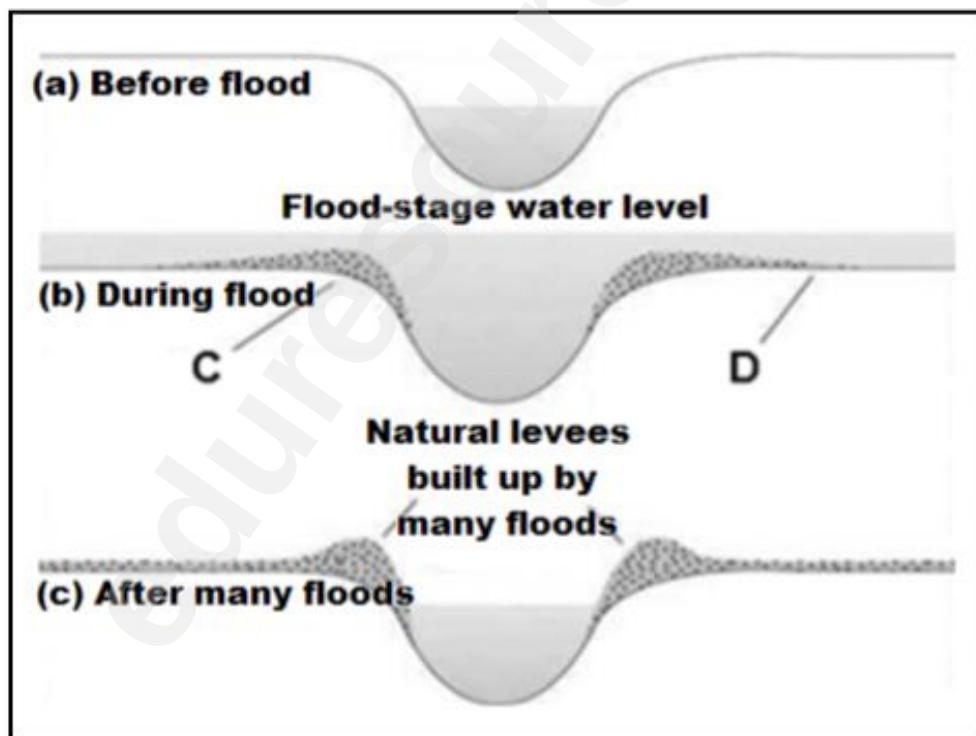
2.6.1 Refer to the formation of a levee in FIGURE 2.6.

- (a) What is a *levee*? (1 x 1) (1)
- (b) Give reasons for the difference in size between the sediment deposited at **C** and the sediment deposited at **D** in FIGURE 2.6. (2 x 2) (4)
- (c) Explain why levees can be both advantageous and disadvantageous to farming on the adjacent flood plain. (2 x 2) (4)

2.6.2 The following questions refer to deltas.

- (a) Where are deltas found in a river? (1 x 2) (2)
- (b) Give a reason for the large quantities of deposited material found where a delta is formed. (1 x 2) (2)
- (c) Why are deltas rare in South African rivers? (1 x 2) (2)

FIGURE 2.6: FORMATION OF A LEVEE

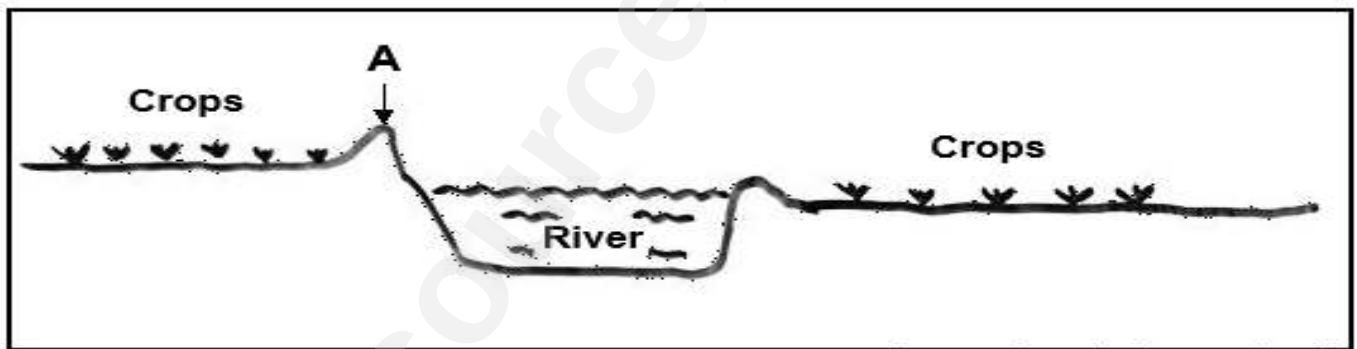


[Adapted from <http://www.nasa.gov/slang>]

NOVEMBER 2014

- 1.6 Refer to FIGURE 1.6 showing a levee.
- 1.6.1 Identify the fluvial landform on which crops are grown. (1 x 1) (1)
- 1.6.2 Why is the landform in QUESTION 1.6.1 more likely to flood in the lower course? (2 x 2) (4)
- 1.6.3 Identify the natural feature **A** that protects crops from flooding. (1 x 2) (2)
- 1.6.4 Briefly describe the formation of the natural feature in QUESTION 1.6.3. (2 x 2) (4)
- 1.6.5 Discuss the negative impacts on the farmer, should the river break through feature **A**. (2 x 2) (4)

FIGURE 1.6: LEVEE



[Source: Examiner's own sketch]

RIVER GRADING:

1. GRADED RIVER > a river that has reached its equilibrium between its gradient, volume and channel shape.

Graded river has sufficient energy to flow with erosion rates in balance with the deposition rates.

2. OVERGRADED RIVER > a river that have excess energy and erode their channels. They carry a heavy load and flow quickly.

3. UNDERGRADED RIVER > a river that do not have enough energy to flow and to transport their load. They deposit some of their material.

REJUVINATION OF RIVERS:

REJUVINATION > is when a river gains renewed energy and erode downwards again.

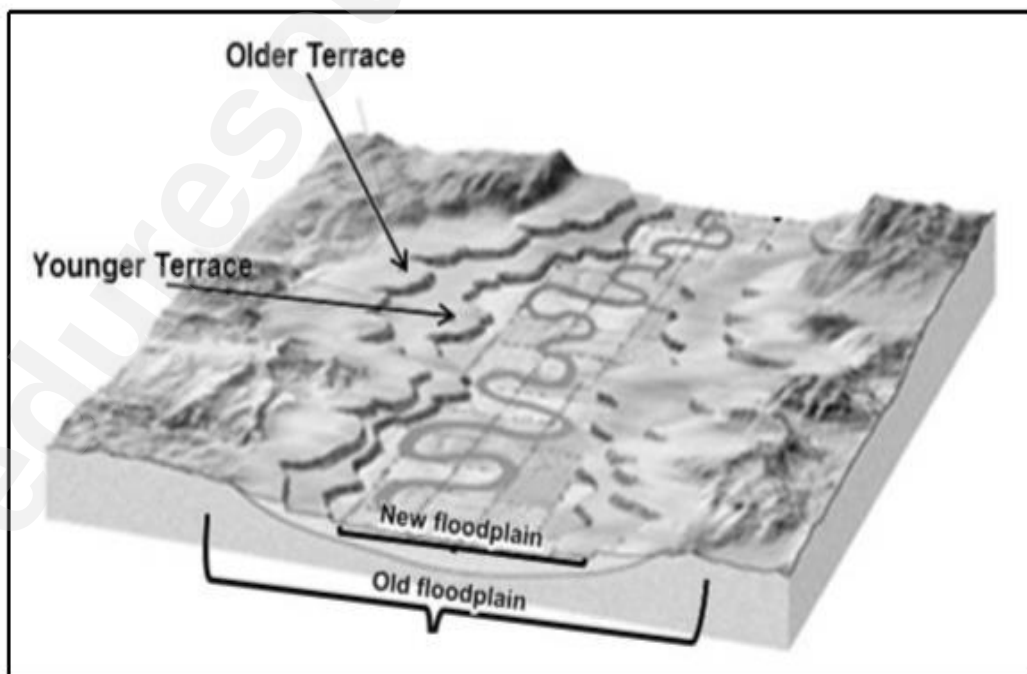
- A REJUVINATED RIVER IS AN OVERGRADED RIVER.
THE FOLLOWING LANDFORMS ARE FORMED DUE TO REJUVINATION:
1. INCISED OR ENTRENCHED MEANDERS.
 2. KNICKPOINT WATERFALLS.
 3. VALLEYS WITHIN THE VALLEYS
 4. TERRACES.

FEB / MARCH 2018

1.5 Refer to FIGURE 1.5 which shows a floodplain after rejuvenation.

- 1.5.1 What is a *floodplain*? (1 x 1) (1)
- 1.5.2 What evidence suggests that rejuvenation has taken place? (1 x 1) (1)
- 1.5.3 In which course of the river is the floodplain located in the sketch? (1 x 1) (1)
- 1.5.4 Floodplains are generally suitable for the cultivation of crops.
- (a) Why are floodplains suitable areas for the cultivation of crops? (2 x 2) (4)
- (b) Explain, in a paragraph of approximately EIGHT lines, the negative impact of rejuvenation on farming activities in the illustrated landscape. (4 x 2) (8)

FIGURE 1.5: FLOODPLAIN AFTER REJUVENATION

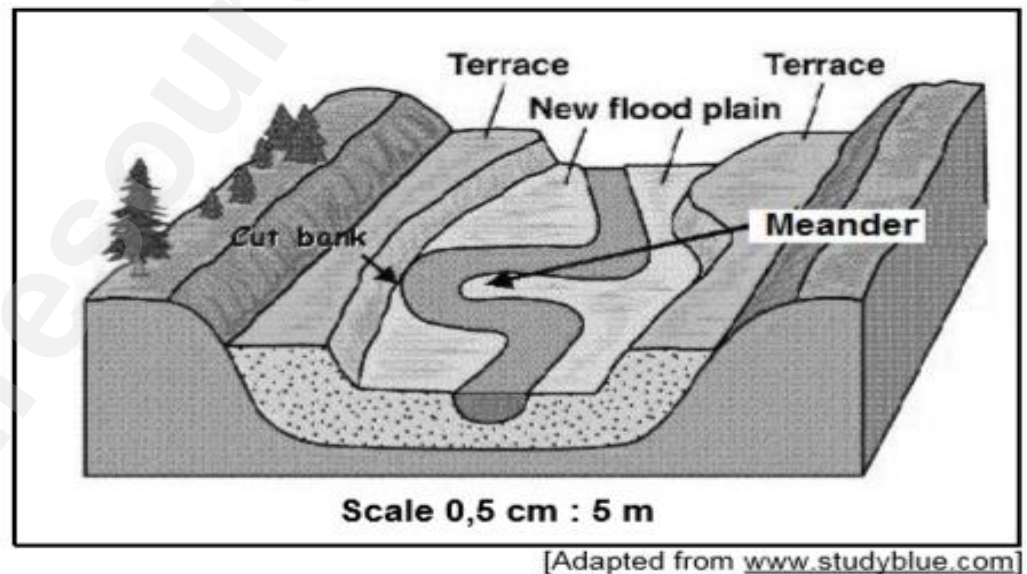


[Adapted from Pearson Education]

NOVEMBER 2017

- 2.5 Refer to FIGURE 2.5 that shows river capture on a superimposed landscape.
- 2.5.1 What is a *superimposed stream*? (1 x 1) (1)
- 2.5.2 What evidence suggests that river **S** and river **Y** are superimposed streams? (1 x 2) (2)
- 2.5.3 Draw a labelled cross-section to show how the abstraction process resulted in river capture in FIGURE 2.5B. (2 x 2) (4)
- 2.5.4 In a paragraph of approximately EIGHT lines, explain the changes that the captured stream will undergo downstream of the elbow of capture. (4 x 2) (8)

FIGURE 2.6: RIVER REJUVENATION



RIVER CAPTURE:

RIVER CAPTURE - It occurs when a river with more energy intercepts another river and captures the water of the other river.

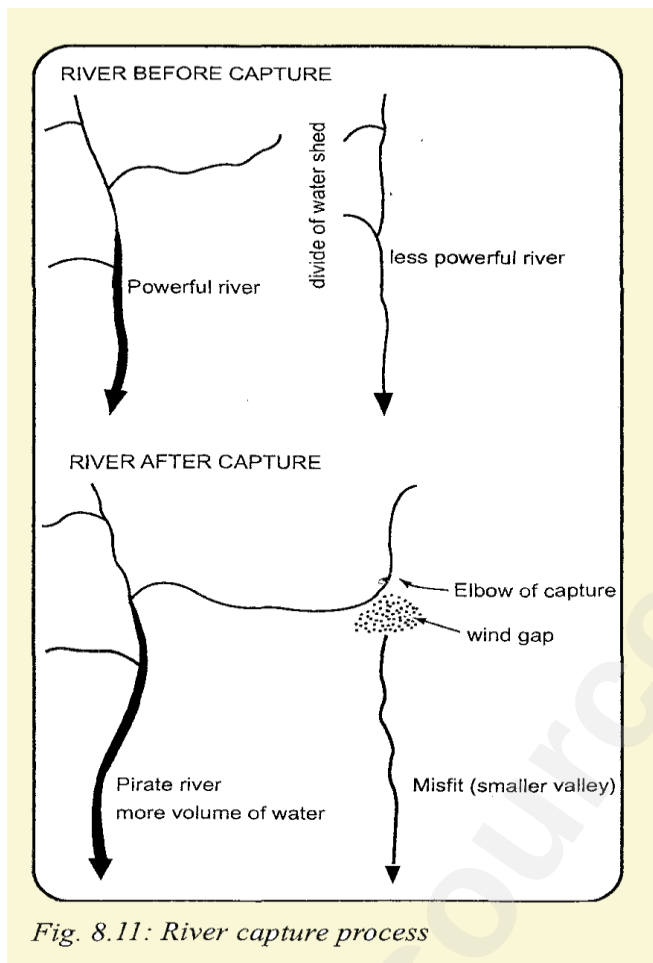


Fig. 8.11: River capture process

FEATURES ASSOCIATED WITH RIVER CAPTURE

1. **CAPTOR OR PIRATE STREAM** > the river with more energy that capture another river.
2. **CAPTIVE STREAM** > the river that has been captured.
3. **MISFIT OR BEHEADED STREAM** > the river that lost its headwaters.
4. **WIND GAP** > the part of the old valley of the captured river. It is now dry and filled with sand and gravel.
5. **KNICKPOINT WATERFALL** > the steep gradient down which the captive stream flowed as it flowed into the captor.

THE RESULTS OF CAPTURE:

- The captor gains water, has more energy and be erosive
- Captive/ captured stream loses its water.

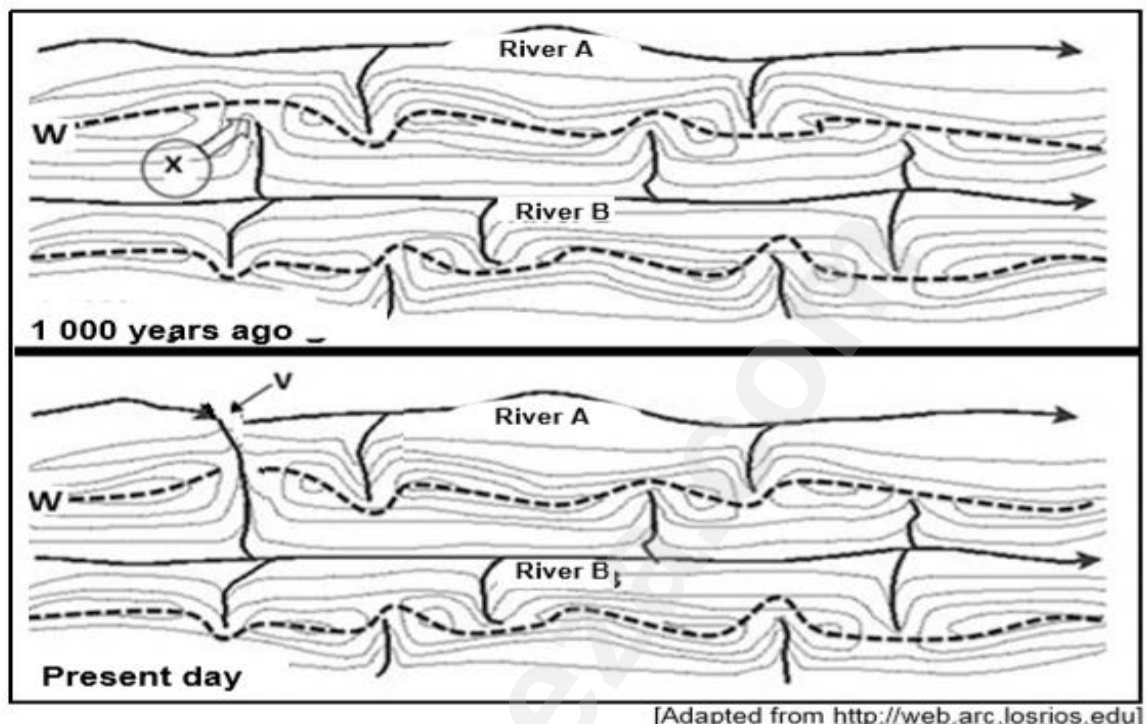
THE EFFECTS OF CAPTOR ON PEOPLE DEPENDING ON CAPTURED STREAM:

- There will be lack of water for domestic use.
- Lack of water for irrigation that could lead to food insecurity.
- Shortage of water for industries.
- Reduction in crop yield.
- Food insecurity will lead to food being expensive.

MAY / JUNE 2016

- 1.5 Refer to FIGURE 1.5, based on stream piracy/river capture.
- 1.5.1 Identify feature **W** in FIGURE 1.5. (1 x 1) (1)
- 1.5.2 What purpose does feature **W** serve? (1 x 1) (1)
- 1.5.3 Explain the process that had to take place over the past 1 000 years for River **B** to be named 'captor stream'. (2 x 2) (4)
- 1.5.4 Give a reason for the large amount of river gravel that is likely to be found at area **V**. (1 x 2) (2)
- 1.5.5 State ONE change that River **B** underwent from 1 000 years ago to the present day. (1 x 2) (2)
- 1.5.6 What implication does stream piracy/river capture have for communities that depend on River **A** for economic activities? (2 x 2) (4)

FIGURE 1.5: STREAM PIRACY/RIVER CAPTURE

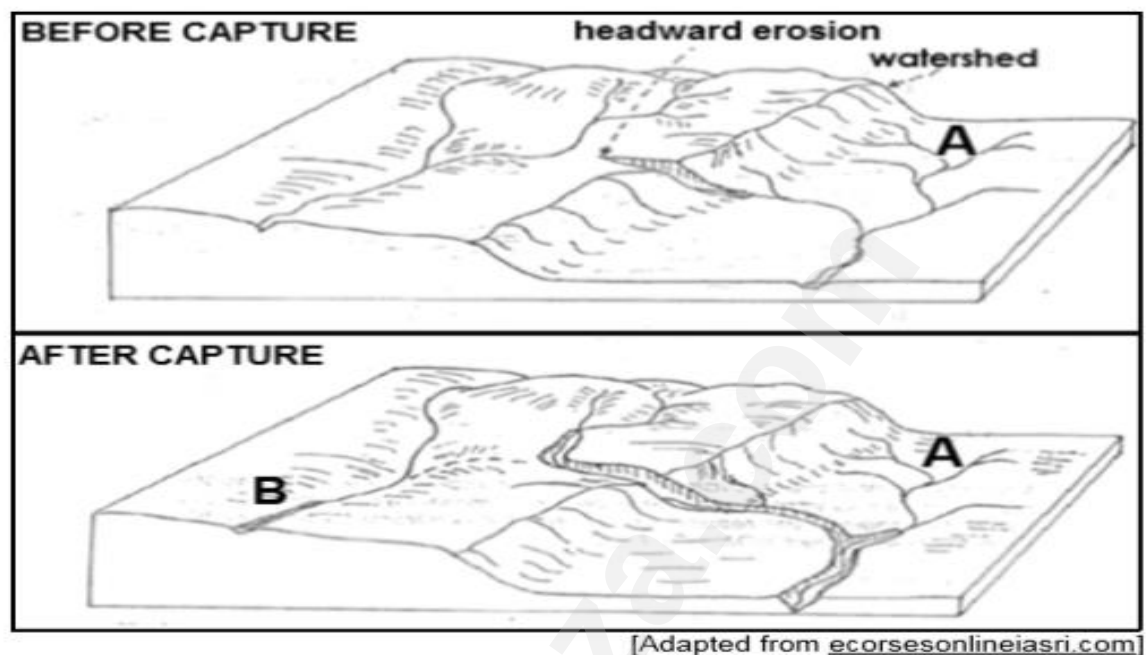


MAY / JUNE 2017

1.6 Refer to FIGURE 1.6, which illustrates river capture.

- 1.6.1 Define the term *river capture*. (1 x 1) (1)
- 1.6.2 What evidence in sketch **A** indicates that river capture is likely to take place? (1 x 1) (1)
- 1.6.3 Name TWO physical changes that river **A** will undergo after river capture has occurred. (2 x 1) (2)
- 1.6.4 State TWO possible conditions that have led to river **A** being the captor stream. (2 x 2) (4)
- 1.6.5 Write a paragraph of approximately EIGHT lines to describe how the reduced volume of water will negatively impact on the farming community at **B**. (4 x 2) (8)

FIGURE 1.6: RIVER CAPTURE

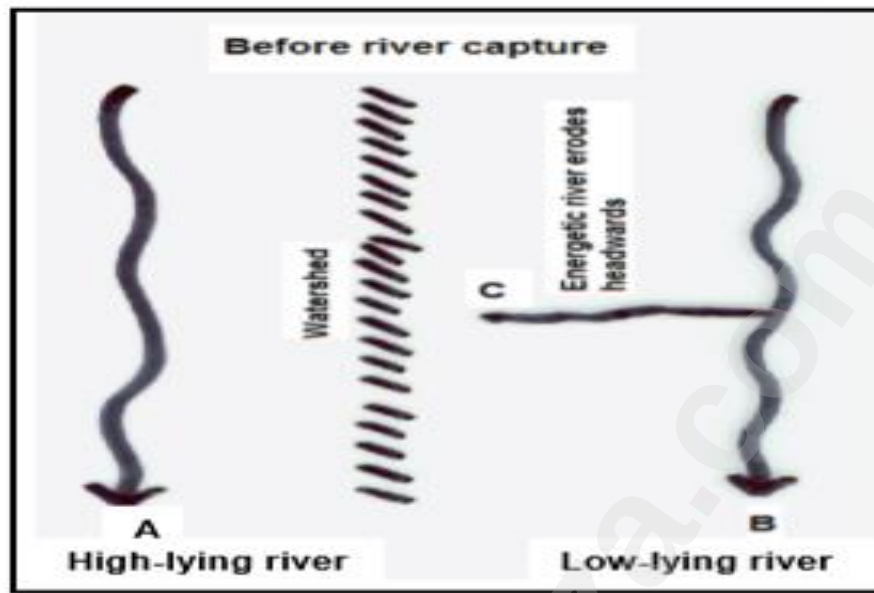


FEB / MARCH 2015

1.5 FIGURE 1.5 is a sketch based on river capture.

- | | | | |
|-------|---|---------|-----|
| 1.5.1 | What is a <i>watershed</i> ? | (1 x 1) | (1) |
| 1.5.2 | Why is the watershed not a permanent feature? | (1 x 2) | (2) |
| 1.5.3 | What does it mean when a stream erodes <i>headwards</i> ? | (1 x 2) | (2) |
| 1.5.4 | Give TWO reasons why tributary C is energetic. | (2 x 2) | (4) |
| 1.5.5 | Draw a plan view sketch (as seen from above) to show the landscape after river capture has taken place. Label at least TWO features of river capture. | (2 x 2) | (4) |
| 1.5.6 | Which of the streams will become rejuvenated after river capture has taken place? | (1 x 2) | (2) |

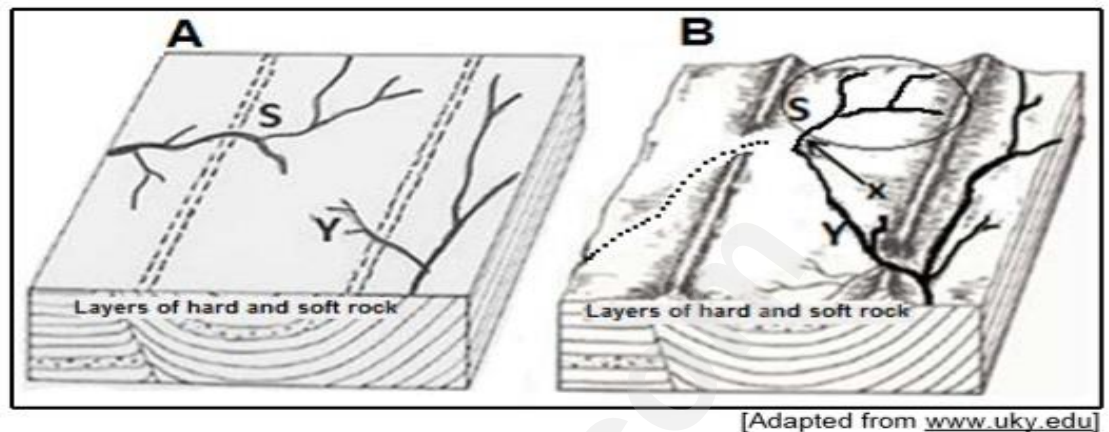
FIGURE 1.5: RIVER CAPTURE



NOVEMBER 2017

- 2.5 Refer to FIGURE 2.5 that shows river capture on a superimposed landscape.
- 2.5.1 What is a *superimposed stream*? (1 x 1) (1)
- 2.5.2 What evidence suggests that river **S** and river **Y** are superimposed streams? (1 x 2) (2)
- 2.5.3 Draw a labelled cross-section to show how the abstraction process resulted in river capture in FIGURE 2.5B. (2 x 2) (4)
- 2.5.4 In a paragraph of approximately EIGHT lines, explain the changes that the captured stream will undergo downstream of the elbow of capture. (4 x 2) (8)

FIGURE 2.5: RIVER CAPTURE



JUNE EXAM 2018

1.5 FIGURE 1.5 indicates river capture.

1.5.1 In diagram 1, river **X** is engaged in headward erosion, rapidly cutting through the watershed.

- Explain the concept *headward erosion*. (1x1) (1)
- Give a reason for river **X** eroding rapidly through the watershed. (1x2) (2)

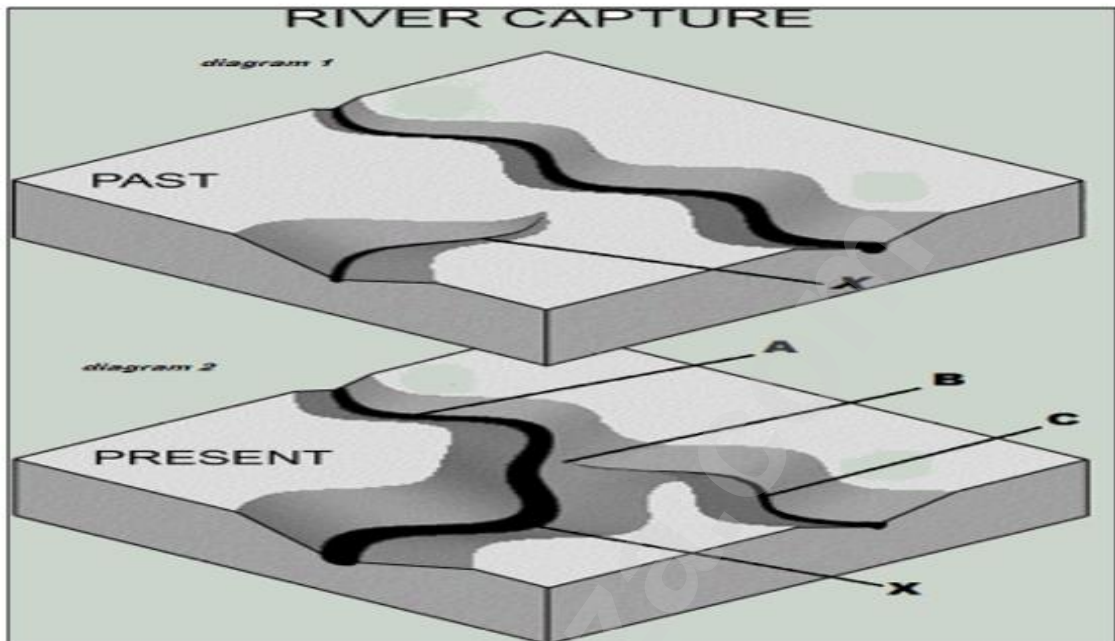
1.5.2 Identify the features of river capture labelled **A**, **B** and **C** in diagram 2. (3x1) (3)

1.5.4 Describe TWO changes that took place in river **X** after river capture occurred. (2x2) (4)

1.5.5 In a paragraph of approximately EIGHT lines, explain the effect of river capture on the stream labeled **C** by referring to the ecosystem and the community living along the river. (4x2) (8)

(18)

FIGURE 1.5 RIVER CAPTURE



SUPERIMPOSED DRAINAGE PATTERN > a river develops a pattern on a surface that has eroded over time. Now the river is flowing on the rocks/ uncovered structure.

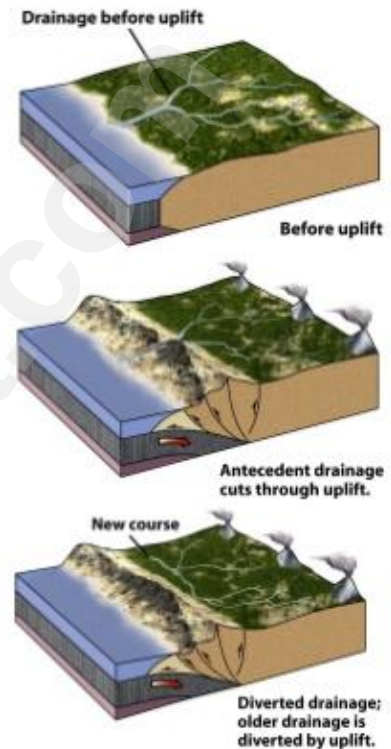
ANTECEDENT DRAINAGE PATTERN > after the river formed, folding or faulting occurred. But the river maintained its pattern, cutting a gorge through the uplifted land.

PICTURES OF SUPERIMPOSED AND ANTECEDENT DRAINAGE PATTERN:

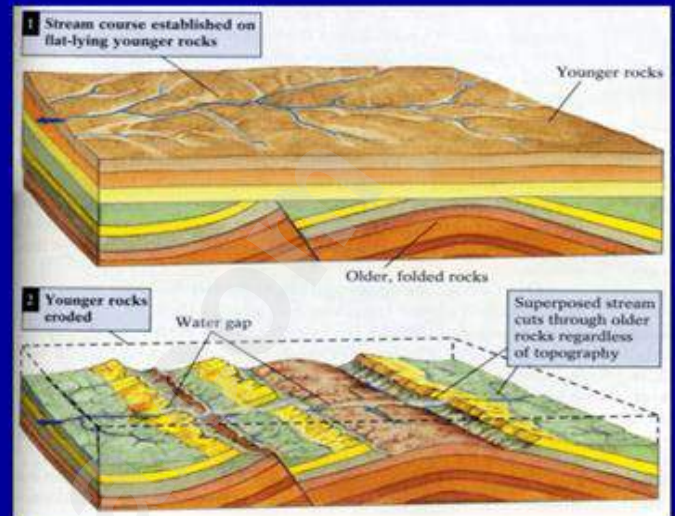
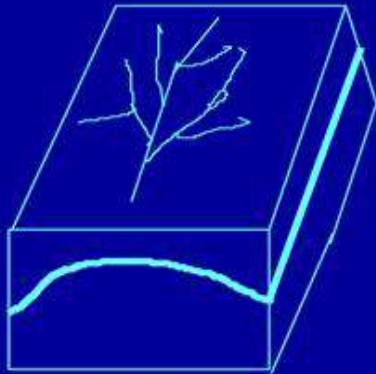
Drainage Evolution

Antecedent drainages

- Tectonic uplift can raise ground beneath established streams
- If erosion keeps pace with uplift, stream will incise into uplift
 - Called antecedent drainage
- If uplift rate exceeds incision, stream is diverted around uplift



Superimposed Drainage



The drainages of that are retaining their original character of the formation in which they were formed but misfit or super imposed over other formation.

THE IMPORTANCE OF WATER:

- For domestic use (cooking, drinking and household use).
- For irrigation.
- For Hydro-Electricity.
- For use in businesses. E.g industries.
- For animals.

IMPACTS OF PEOPLE ON DRAINAGE BASINS AND CATCHMENT AREAS:

- Pollution by human activities. E.g industries, mining and recreational activities.
- Excessive use of fertilizers by farmers.
- Water pollution by leakage of ships/ spilling of oil.
- Land pollution by industries and mines through the release of oil/ chemicals to the land that will end up to the sea.
- Killing of marine life.
- Disturbing ecosystem and bio diversity.

CATCHMENT AND DRAINAGE BASIN MANAGEMENT:

- Fine be imposed to industries that pollute water.
- Educate people about the importance of water.
- Awareness campaign to be conducted.
- Educate/ train farmers on better farming methods.
- Buffering the catchment areas.
- Conservation and restoration of wetlands.
- Avoid construction and settlement on the floodplain.
- The clearing of vegetation(deforestation) and planting of alien trees must be controlled.

NB!! Be able to differentiate between the importance and management of drainage basins and catchment areas.

SEPTEMBER 2018 (KWAZULU NATAL)

2.6 Refer to the article in **FIGURE 2.6** on river catchment management.

- 2.6.1 Define the term *catchment area*. (1 x 1) (1)
- 2.6.2 State how the uncontrolled growth of alien vegetation along the Mthatha river will decrease the potential of hydro-electric power generation in the future. (1 x 2) (2)
- 2.6.3 Explain how human activities upstream along the Mthatha river, could impact on agricultural activities further downstream. (2 x 2) (4)
- 2.6.4 In a paragraph of approximately EIGHT lines, discuss sustainable measures that could be implemented to improve water quality in the Mthatha river catchment area. (4 x 2) (8)

FIGURE 2.6: RIVER CATCHMENT MANAGEMENT

MTHATHA RIVER SYSTEM

Mthatha is a major urban region in the Mthatha river catchment area. Activities such as agriculture, hydro-power generation, urbanisation and industry put a strain on the river system and ground water supply.

Alien trees encroach on the riparian zone (area between river and land) which reduces the natural vegetation along the river banks. Hydroelectric power releases water that scours (scrapes) the river banks and untreated sewage is discharged directly into the river.

Source: Adapted from Study and Master

MAY / JUNE 2017

- 2.6 FIGURE 2.6 is a case study on catchment and river management. Read the article carefully before answering the questions that follow.
- 2.6.1 Name TWO initiatives that the Working for Wetlands programme has put in place for sustainable river management in South Africa. (2 x 1) (2)
- 2.6.2 Why have catchment management programmes been introduced for South African rivers? (1 x 2) (2)
- 2.6.3 Explain the role of wetland restoration in maintaining a good water supply in South African rivers. (2 x 2) (4)
- 2.6.4 Discuss the negative impact of human activities on catchment areas in South Africa. (3 x 2) (6)

FIGURE 2.6: CATCHMENT AND RIVER MANAGEMENT

**CASE STUDY ON CATCHMENT AND RIVER MANAGEMENT:
WORKING FOR WETLANDS**

Covering many South African river basins, the Working for Wetlands programme operates in all major catchments.

Half the wetlands lost

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

Future projections indicate that by 2025 the country's water requirements will outstrip supply, unless urgent steps are taken to manage the resource more sustainably.

There are already major problems of supply and quality, with an estimated 8 million South Africans currently having no access to drinkable water.

It is against this background that the South African government, working in partnership with WWF and others, has initiated catchment management programmes. These include the control of water-thirsty alien plant infestations and wetland restoration across the country.

[Source: http://www.panda.org/about_our_earth/about_freshwater/rivers/irbm/cases/southafrica_river_case_study.cfm/]

MAY / JUNE 2016

FIGURE 1.6: IMPACT OF PEOPLE ON RIVERS



[Source: <http://www.groundup.org.za>]

- 1.6 Refer to FIGURE 1.6, a photograph showing the impact of people on rivers.
- 1.6.1 What does the term *river management* mean? (1 x 1) (1)
- 1.6.2 Which government department is responsible for the health and sustainable use of rivers? (1 x 1) (1)
- 1.6.3 What evidence in the photograph indicates poor river management? (2 x 1) (2)
- 1.6.4 Recommend TWO ways in which the municipality can reduce the impact of informal settlements on rivers. (2 x 2) (4)
- 1.6.5 Write a paragraph of approximately EIGHT lines in which you give reasons why it is crucial (very important) to maintain the health (or quality) of rivers in South Africa. (4 x 2) (8)

FREE STATE SEPTEMBER 2019

2.6 Refer to FIGURE 2.6, an article about river pollution.

2.6.1 Name ONE other province that depends on Vaal River for water. (1 x 1) (1)

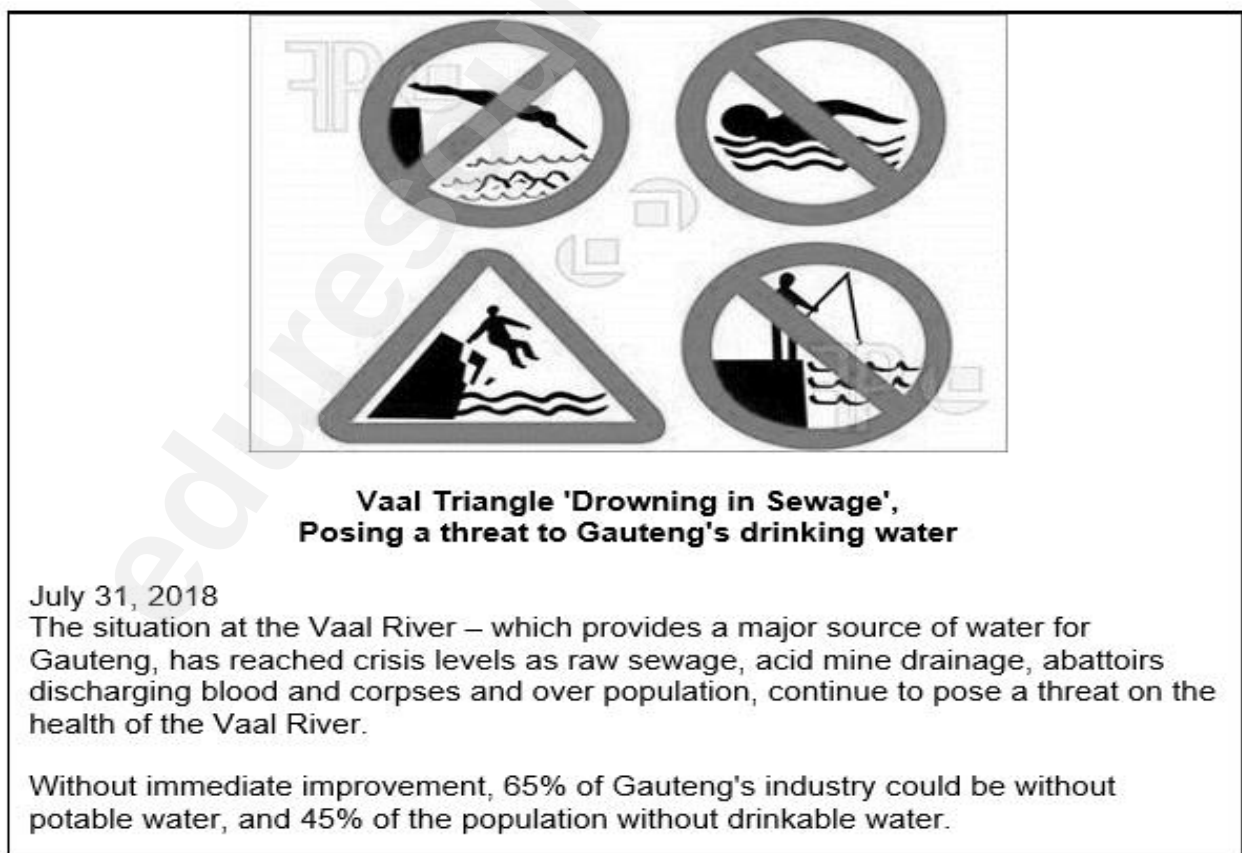
2.6.2 Account for the high level of pollution in the Vaal River. (2 x 1) (2)

2.6.3 Which sectors will be affected the most if immediate improvement is not implemented to rescue the Vaal River? (2 x 1) (2)

2.6.4 Describe the consequences of river pollution on the community depending on the Vaal River (1 x 2) (2)

2.6.5 Suggest in a paragraph of approximately EIGHT lines sustainable strategies that the government could implement to solve the problem of water pollution in South African rivers. (4 x 2) (8)

FIGURE 2.6: RIVER POLLUTION



[Source: Jennie Baxter]