

AIR MASSES

An air mass is a large body of air with uniform horizontal temperature and humidity conditions.

Air masses form when stationary air settles over a large uniform surface area for long, enabling it to acquire uniform conditions.

As an air mass blows, it carries its characteristics acquired from the source (origin) or along the way to new areas hence influencing weather and climate of affected areas.

The source of air mass includes:

- Warm tropical or sub-tropical oceans
- Warm tropical or sub-tropical continents.
- Tropical or sub-tropical deserts
- Cold high latitude oceans i.e Arctic and sub-Arctic oceans.
- Very cold snow-covered high latitude surface that's Arctic, Antarctic and Polar Regions.

TYPES OF AIRMASSES

Air masses are classified basing on their source region and also basing on the underlying surface over which the air mass originates

Broadly there are 2 types of air masses:

1. POLAR AIRMASSES:

These are air masses which originate over cold regions (either land or water) in high latitudes and move towards the equator (lower latitudes). There are **two types** of polar air masses.

a) Polar Maritime air mass:

This type of air mass is called polar maritime because it originates from the water regions of the poles. It originates over the cold ocean waters of the North Pacific and North Atlantic and Arctic oceans.

This air mass has great **influence on weather and climate:**

It brings heavy winter rains, snow in the mountains, and persistent coastal fog in summer in USA.

b) Polar continental air mass

This is cold and dry air mass that originates from the continental interiors (land mass) of the poles for example Northern Tundra of North America, Greenland and Asia.

During winter, this air mass is very cold because its source regions are snow-capped with low temperatures.

During summer when the source regions are warm, the air mass takes on mild (warm) conditions.

2. TROPICAL AIRMASSES;

These are air masses (Air currents) which originate from the low latitudes and move to the higher latitudes (Polar Regions).

There are **two types** of tropical air masses;

a) Tropical maritime air mass (S.E Trade winds)

This type of air mass is called tropical maritime because it originates from the tropical oceans where temperatures are generally high. This air mass is very warm and humid, and usually originates from Atlantic Ocean.

The **weather associated** with this air mass is **sea fog over coastal areas, heavy rainfall and high humidity.**

b) Tropical continental air mass (NE Trade winds)

This type of air mass is called tropical continental because it originates from the tropical land mass. It is hot and dry air mass because it originates from sub-tropical deserts along latitude 35⁰-40⁰ north of the equator.

It is associated with **weather conditions** for example **cloudless skies, fog.**

As it travels over the Mediterranean Sea, it cools, picks some moisture which it drops as isolated showers and thunder storms north of Mediterranean coast.

CHARACTERISTICS OF AIRMASSES.

1. Air masses can be warm or cold depending on its source or origin. Air masses originating from the tropics that's tropical air masses are warm while those originating from the poles that's polar air masses are cold.
2. Air masses can be maritime or continental depending on the path taken. When the underlying surface is water (ocean), air masses are maritime and when the underlying surface is land (continent), the air masses are continental.
3. Air masses blow from high pressure to low pressure regions.
4. Air masses have uniform humidity condition
5. Air masses have uniform temperature
6. They have a definite direction of movement from a definite source region

7. Air masses may modify completely or partially conditions of areas they blow over.
8. Air masses converge at fronts.

FORMATION OF AIR MASSES

Air masses form because of the following **factors (Causes)** that influence formation process:

1. **Difference in temperatures:** Difference in temperatures at the source (origin) and the surrounding areas create difference in atmospheric pressure which will lead to movement of air.

Areas with hot (high) temperature have low pressure while areas with cold (low) temperature have high pressure.

Air moves from regions of high pressure to regions of low pressure thus causing evolution of air masses.

2. Coriolis force

The rotation of the earth results into the formation of a drag force known as Coriolis force.

Any free body on the earth's surface is deflected to its right in the northern hemisphere and to its left in the southern hemisphere. This therefore offsets the movement of air causing development of air masses.

3. Nature of the earth's surface.

Air masses develop over areas which are extensive and uniform e.g desert surface like Sahara desert or ocean surface like Arctic Ocean. These result into a large mass of air having same characteristics in terms of temperature and humidity.

4. Path taken by the air.

The path taken by the air may be either a water surface or land surface. Near the ground however, friction tends to reduce the power of deflection due to rotation.

Over water this effect is greatly minimized hence determining the general flow and speed of air mass over the surface.

INFLUENCE OF AIR MASSES ON THE CLIMATE OF EAST AFRICA.

The air masses that affect the climate of East Africa are:

- ❖ Tropical maritime(marine) air mass (South East Trade winds)
- ❖ Tropical continental air mass (North East Trade winds)
- ❖ The Westerlies.

They have the following effects on the climate of East Africa:

1. When the south east trade winds move over the Indian Ocean, they pick up moisture causing cloudy conditions and heavy rainfall to the coastal areas for example Dar-es-salaam, Zanzibar, and Pemba.
2. As they move over the mainland Tanzania, they lose their moisture resulting in less rainfall, clear skies and generally dry conditions e.g. in Morogoro.
3. When they reach Lake Victoria, they get recharged with moisture and are deflected towards the right at the equator thereby bringing conditions of high humidity, cloudy and wet conditions (rainfall) over the northern and north eastern Lake Victoria shores.
4. The tropical continental air masses (N.E Trade winds) on the other hand originate from the Arabian landmass. As they blow over the Ethiopian highlands, moisture in them is lost rendering them hot and dry air masses. They bring the following climatic conditions over North Eastern Uganda and Northern Kenya i.e.
 - ❖ Low humidity
 - ❖ High temperatures
 - ❖ Clear skies
 - ❖ Low and unreliable rainfall.
5. Sometimes the tropical maritime and tropical continental air masses meet at the inter-tropical convergence zone (ITCZ). In the process the warm moist tropical maritime air mass is forced to rise giving rise to cumulo-nimbus cloud, light variable winds and frequent thunderstorms (convectional rainfall).
6. The westerly (Tropical westerly) air masses blow over the Congo basin. These winds are warm and moist and as they blow eastwards, cause heavy relief rainfall in the wind ward slopes of mountain Rwenzori.
 - They however, descend the leeward slopes as dry winds causing low cloud cover, lower rainfall and low humidity in Kasese, Masindi, and Buliisa etc.

Questions:

- 1a) what is meant by an air mass?
 - c) Explain the influence of air masses on the climate of East Africa.
 - d) Describe the weather conditions associated with the meeting of air masses over the East Africa.

Approach

- a) What is meant by an air mass?
 - Define air mass
 - Explain the causes
 - Identify the types
 - Identify characteristics
- b) Explain the influence of air masses on the climate of East Africa
3. Describe the weather conditions associated with meeting of air masses over the East African region

Approach:

Clue: - Describe the effect/influence of air masses on weather conditions in E. Africa.
Same approach and content (points) as in question (b) above.

Refer to notes on influence of air masses on climate in E.A.

FRONTS

A front is a narrow zone separating air masses with different characteristics (i.e. temperature and humidity) which are brought together but do not mix freely.

TYPES OF FRONTS

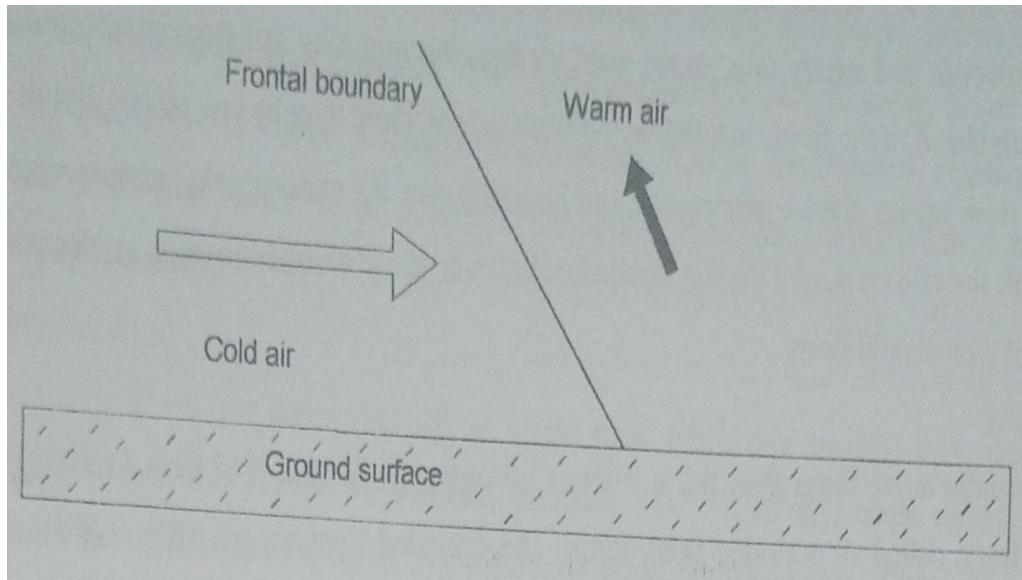
There are **3** types of fronts:-

1. Cold front:

This occurs when cold air invades (moves into) a zone of warm air.

The cold air being heavier remains in contact with the ground and forces the warmer air to rise over it.

The slope of the cold front is steep due to the rapid cooling of the warmer air.

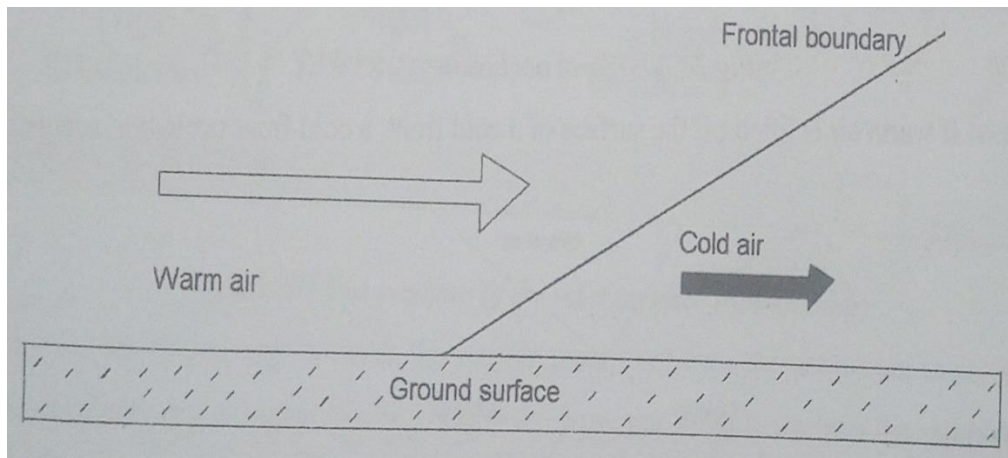


As the cold air lifts the warm air, the warm air becomes unstable, develops strong convectional activity and condenses to form cumulo-nimbus clouds; therefore, cold fronts are associated with **heavy rainfall** and **thunder storms** as well as **strong winds**.

2. Warm front

This marks the region where warm air is replacing cold air.

Warm air moves into a region of cold air.



Here again the cold air mass remains in contact with the ground and the warm air mass is forced to rise.

An average warm front has a gentler slope than that of the typical cold front.

Warm front is associated with **strato clouds** and stable atmospheric conditions.

Warm fronts are best developed in winter.

As the warm front passes the air temperature and humidity rise.

3. Occluded front

Cold fronts usually move faster than the warm fronts. Consequently, when a cold front overtakes a warm front, a new front called occluded front forms.

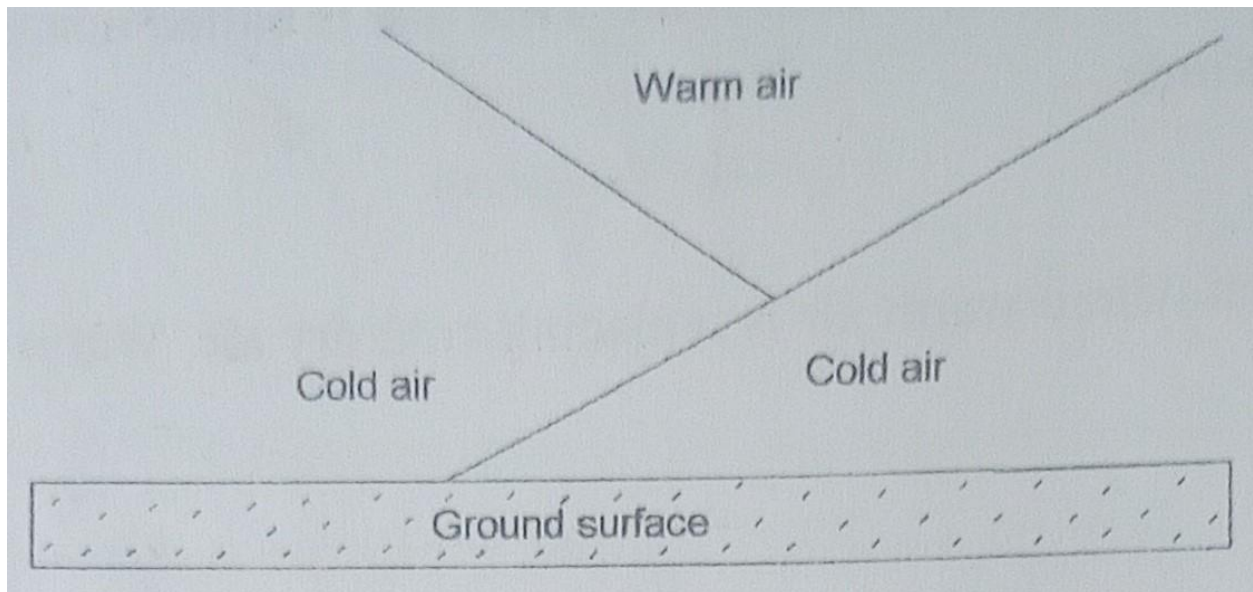
An occluded front occurs when cold air advances in a warm air mass cutting it off completely from the ground.

The warm air thus lies above while the cold air forms a cushion below.

There are **2** types of occluded fronts (occlusions):-

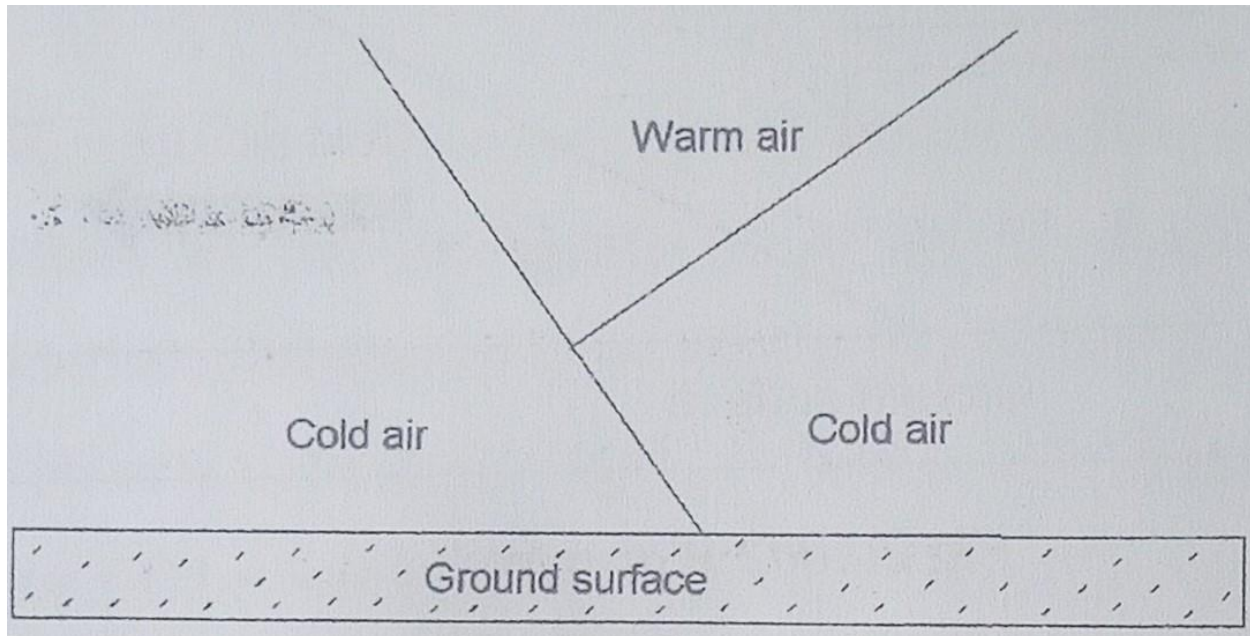
a) Warm occlusion

This occurs when warm air is lifted off the ground at a warm front.



b) Cold occlusion:

This occurs when warm air is lifted off the ground at a cold front.



FRONTAL ZONES

There are **2** frontal zones on the earth's surface

1. Polar front

This is a boundary area which separates the polar air masses from the tropical air masses.

The position of the polar front varies from season to season.

In winter the front is situated to the south and extends from the central-eastern sea board of North America to Spain.

In summer, the front moves northwards and stretches from New found land across Norway.

2. Inter-tropical front.

This region lies in the equatorial belt. Here trade winds/air masses from the northern latitudes meet the trade winds from the southern latitudes.

CYCLONES (DEPRESSIONS)

A cyclone/depression is a mass of air whose isobars form an oval or circular shape where pressure is low in the centre and increases towards the outside.

It is a low pressure wind system (storm) that moves at an averagely high speed of 25 kilometers per hour with a diameter of between 80 kilometers and 400 kilometers.

TYPES OF CYCLONES (DEPRESSIONS)

There are **2** types of cyclones/depressions

1. Temperate cyclones/depressions
2. Tropical cyclones

TEMPERATE CYCLONES

Temperate cyclones/depressions are dominantly located in the temperate regions between 40° - 60° north and south of the equator for example in North West Europe, British Columbia, Alaska and the coast of Chile.

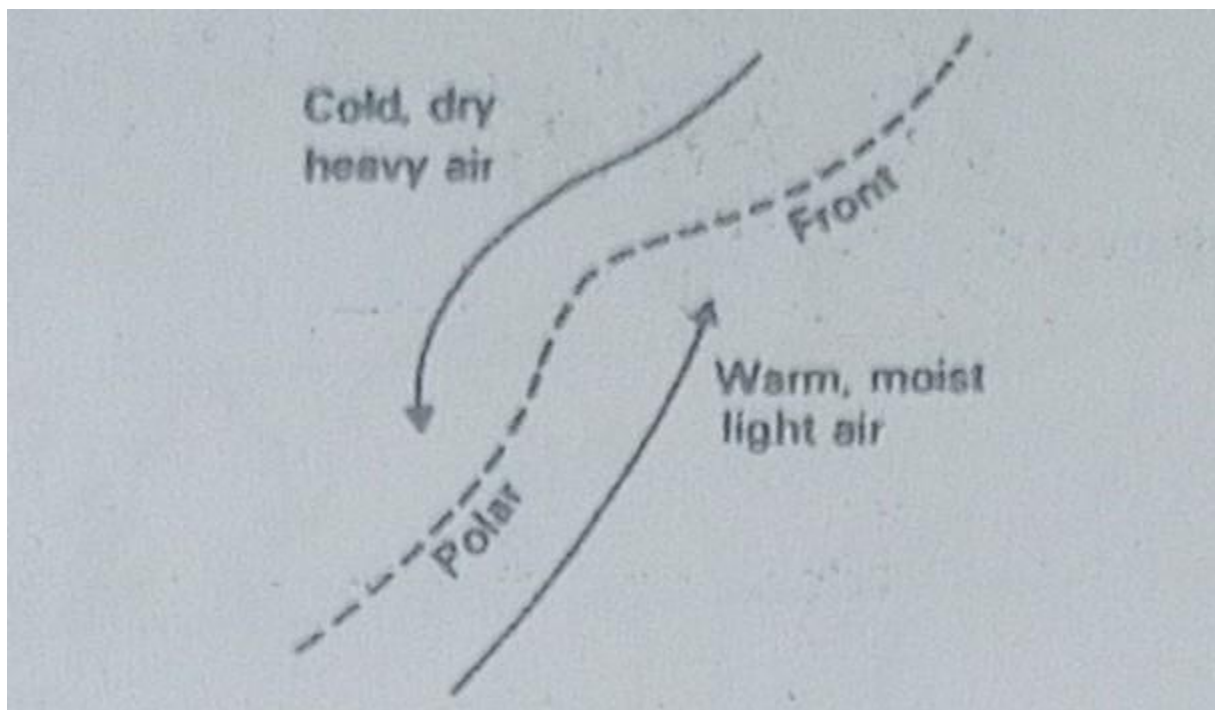
They are caused by mixing of cold air from the Polar Regions with warm humid air from the tropical regions.

FORMATION OF TEMPERATE CYCLONES

Temperate cyclones originate from direct interaction between 2 different air masses, one of tropical origin and the other of polar origin.

The meeting of these air masses occurs at the polar front and because the air masses have different characteristics they cannot mix freely and a depression develops.

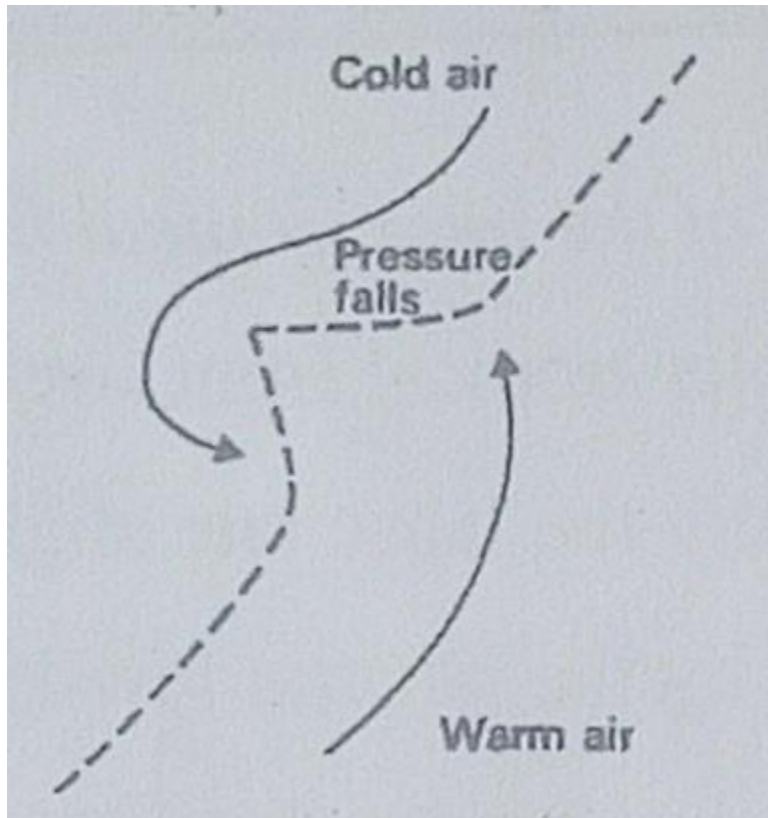
Along the polar front, cold polar air moves in a general easterly direction. The frictional effect of the air masses causes a wave to develop.



The wave bulges into the colder air and gets larger

Pressure falls at the tip of the wave and an anti-clockwise circulation of winds blows around this low pressure point in the northern hemisphere.

In the southern hemisphere the wind circulation is clockwise.



CHARACTERISTICS OF TEMPERATE CYCLONES

1. They are located in the temperate regions between 40° - 60° north and south of the equator.
2. Lowest pressure is found at the center of the depression.
3. Highest pressure is found at the periphery (outside) of the system.
4. Air circulates around the point of low pressure. This circulation is clockwise in the southern hemisphere and anti-clockwise in the northern hemisphere.
5. Winds blow towards the center which is a zone of low pressure
6. They develop over sea or ocean water.
7. They affect small area which may not reach 150 kilometers off the coast.
8. They have cyclic form of circulation capable of movement, growth and decays.

WEATHER CONDITIONS ASSOCIATED WITH TEMPERATE CYCLONES (DEPRESSIONS)

At the warm front where warm air rises over the cold air, the following weather conditions occur:

1. As warm air rises over the cold air, condensation occurs forming cirrus clouds and rainfall.
2. Winds blow in an easterly or south-easterly direction
3. Winds are accompanied by fairly low temperatures.
4. Later the cirrus clouds are replaced by stratus and cumulus clouds which cover the whole sky
5. Much of the precipitation starts to fall as snow.
6. With the passage of the warm front and arrival of the warm sector, temperatures rise, pressure falls
 - Winds change direction from easterly to westerly or south westerly direction on the arrival of the warm sector.
 - Advection fog is common in winter as the warm front passes.

At the cold front, cold air forces its way under the warm air resulting into the following weather conditions.

1. Winds change direction from southwest to north west
2. Temperatures fall
3. Pressure rises
4. Short but heavy rainfall occurs.
5. Once the cold front passes, there is rapid improvement in visibility.
6. Temperature inversion occurs.

TROPICAL CYCLONE (DEPRESSION)

A tropical cyclone is an intense low pressure wind system with a steep barometric gradient in which air circulates towards the center. It is a violent tropical storm.

Tropical cyclones occur in the tropics between **5°** and **20°** north and south of the equator. They are called by different names for example:

In Asia they are called **Typhoons**; in America or West Indies they are called **Hurricanes**, in Australia (off the coast of Queensland) they are called **Willy –willies**, and within the Indian Ocean they are simply called **cyclones**.

FORMATION OF TROPICAL CYCLONES

Tropical cyclones develop along the inter-tropical front where the trade wind air masses converge. These air masses over the oceans have moist lower layers but drier upper layers.

When **two** such air masses meet, one of them will tend to be lifted up (i.e. warm air).

The friction effect of the **2** air flows causes a wave to develop which budges into colder air and gets larger.

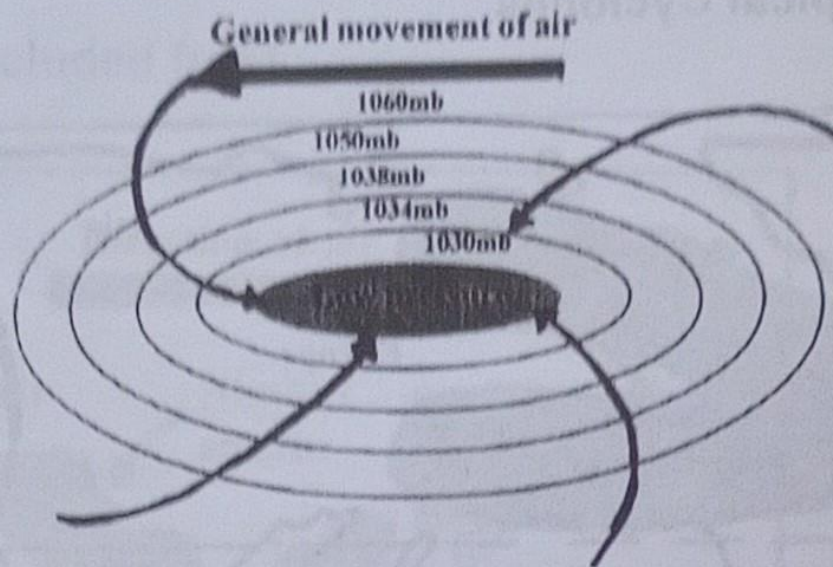
The pressure suddenly falls at the tip of the wave (low pressure in the center) and an anti-clockwise circulation of winds blows around this low pressure point in the northern hemisphere and clockwise in the southern hemisphere.

Tropical cyclones move at high speed of over 120 kilometers per hour and are very destructive storms for example Tornado and Hurricanes in USA.

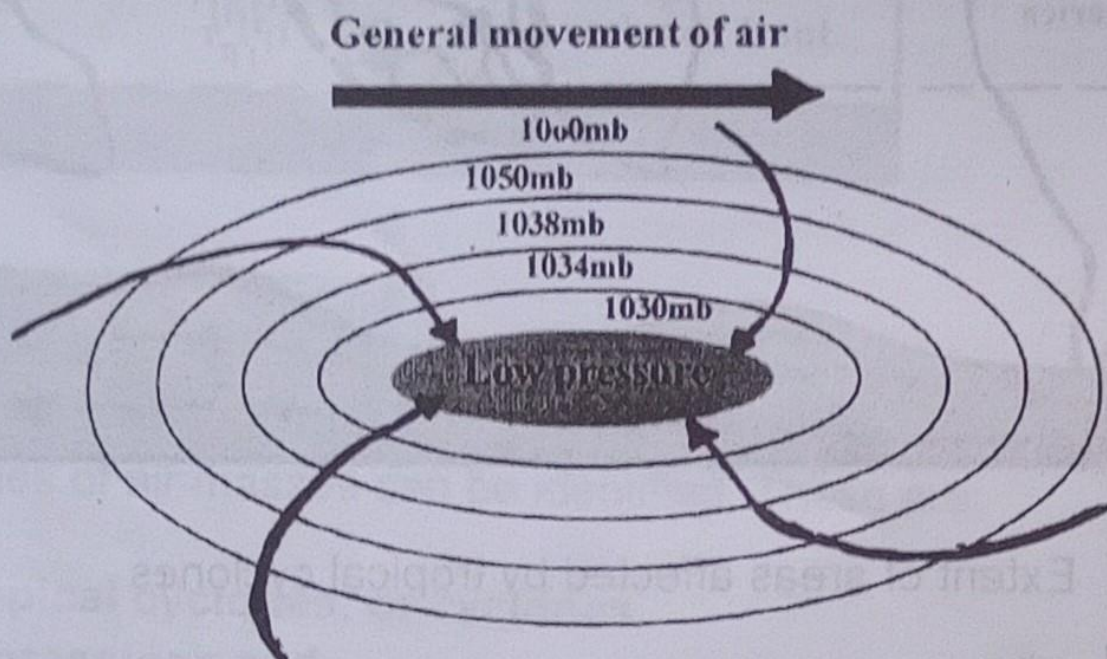
CHARACTERISTICS OF TROPICAL CYCLONES

1. They originate from within the tropical latitudes usually between 5° and 20° north and south of the equator.
2. They are low pressure systems that's atmospheric pressure is lower at the center than the periphery (outer zones)
3. They cover a diameter of between 80-400 kilometers.
4. Winds circulate towards the center because of the barometric gradient that's winds blow from high pressure to low pressure zones.
5. Circulation of the winds (air) is in anti-clockwise direction in the northern hemisphere and clockwise direction in the southern hemisphere.

The cyclone in the Northern Hemisphere



The cyclone in the Southern Hemisphere



6. Winds move at high speed; average of 200 kilometers per hour hence tend to be destructive.
7. Tropical cyclones are strong winds and are characterized by lightning and thunderstorms.
8. They develop over water especially over large oceans and seas with high temperatures of at least 27°C. They never originate over land.
9. They originate from the western sides of the oceans and affect the eastern sides of continents.
10. The centre of the tropical cyclone (i.e. the “eye”) is characterized by calm atmospheric conditions i.e. there is calm, clear, dry air that is stable.
11. They have violent peripheries (vortex) characterized by strong winds, thunder storms and cloudy conditions.
12. They usually occur between July and October in the northern hemisphere and January to April in the southern hemisphere.
13. They tend to be circular and mobile and they are capable of moving from one region to another and later decay as they blow over land.
14. The direction of movement of cyclones is basically determined by wind direction.

WEATHER CONDITIONS ASSOCIATED WITH TROPICAL CYCLONES (EFFECTS ON WEATHER).

Tropical cyclones/depression influence the weather conditions i.e. winds, pressure, humidity, clouds and rainfall.

The weather conditions vary with vortices (i.e. peripheries of the cyclones) and the “eye” (centre) of the cyclone.

a) WEATHER CONDITIONS IN THE ADVANCE VORTEX (FRONT PERIPHERY)

1. There is decreasing atmospheric pressure
2. There is increasing wind speed and winds tend to be violent i.e. surge upward at high speed of an average of 150-200 kilometers per hour.
3. There is development of dense cloud cover due to surging up of humid winds that then condense.
4. Heavy rainfall with lightning and thunderstorms which may exceed 500 millimeters in only 24 hours occurs.
5. There is reduced visibility due to low and dense cloud cover as well as stormy conditions.

6. Temperatures tend to be hot accounting for the great evaporation and consequent humidity.

b) WEATHER CONDITIONS IN THE EYE OF THE CYCLONE (STORM)

7. There are calm winds i.e. light and stationary winds.
8. Temperatures are generally hot.
9. There are bright and dry conditions
10. The skies are very clear with hardly any clouds.

c) WEATHER CONDITIONS IN THE REAR VORTEX

11. There is low but rising atmospheric pressure.
12. There are strong winds with high speed between 120-200 kilometers per hour
13. Winds have vertical instabilities i.e. they are rising
14. There are thick and dense clouds
15. There is heavy rainfall accompanied by thunderstorms
16. There is high humidity.

EFFECTS OF TROPICAL CYCLONES IN AREAS WHERE THEY OCCUR:

- ❖ Destruction of life and property e.g. in 1990 tropical storms killed over 200 people and destroyed over 1400 villages in India.
- ❖ It leads to flooding which destroys property, lives and spread of water borne diseases e.g. in 2005, Hurricane Katrina caused flooding in New Orleans, Louisiana.
- ❖ It leads to famine because it destroys crops.
- ❖ It leads to heavy rains and landslides e.g. in 1998 Hurricane Mitch's torrential rain caused floods and landslides that killed over 9000 people in Central America.

Questions

- a) What is a tropical cyclone?

Approach:

- ❖ Define cyclone and tropical cyclone
 - ❖ Identify areas where it occurs
 - ❖ Mention different names of tropical cyclones
 - ❖ Describe the characteristics of tropical cyclones.
 - ❖ Explain formation
- b) Describe the weather conditions associated with tropical cyclones

Approach

Describe the weather conditions at the front (advance) vortex, eye and rear vortex of the storm/cyclone.

ANTICYCLONES

An anticyclone is a system of atmospheric pressure associated with the Horse latitudes (Sub-tropical highs) in which there is high pressure at the center and descending low pressure towards the periphery of the system.

It is a mass of air whose isobars form an oval or circular shape where pressure is high in the center and decreasing toward the outside.

Anticyclones are large and often affect whole continents

They form outside the tropics at the horse latitudes where air is subsiding.

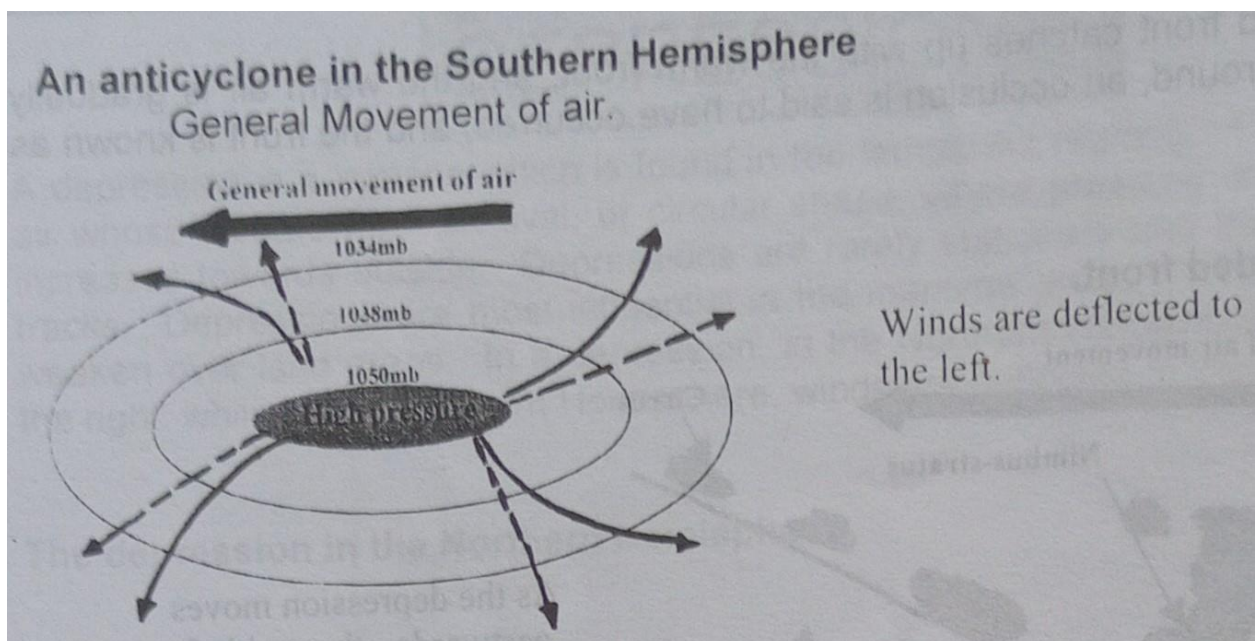
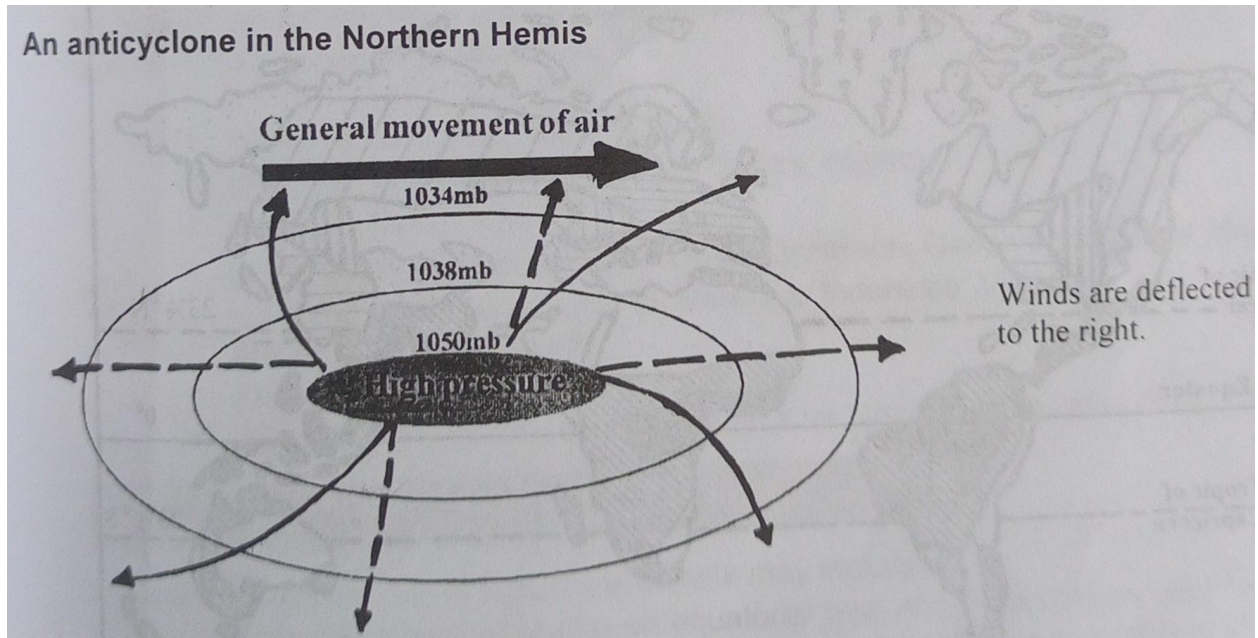
Anti-cyclones are divided into two main group's i.e. **cold** and **warm** anticyclone.

Warm anticyclones are characterized by cold dense air in the lower troposphere with relatively warm air above a level of 1000 feet.

Cold anti-cyclones on the other hand are relatively shallow features related to surface chill of Polar Regions.

CHARACTERISTICS OF ANTI-CYCLONES

1. The movement of an anticyclone is clockwise in the northern hemisphere and anti-clockwise in the southern hemisphere.



2. Their general direction of movement is to the eastern direction and the movement is caused by the earth's rotation.
3. Anti-cyclone may remain stationary before gradually fading out.
4. They blow outwards from the center which is a high pressure zone.
5. Movements of anti-cyclones is slow as compared to tropical cyclones (depressions)
6. Anticyclones develop on land. The friction on land partly reduces their speed.
7. They develop outside the tropics i.e. north of the tropic of cancer and south of the tropic of Capricorn.
8. They affect larger areas of continents hence they are larger than cyclones.
9. They have highest atmospheric pressure at the center which decreases towards the outside.

WEATHER CONDITIONS (CHARACTERISTICS) ASSOCIATED WITH ANTICYCLONES (THEIR EFFECTS ON WEATHER)

1. During winter seasons, anti-cyclones are associated with light cloudy, cold frosty and clear day sunny weather.
2. During winter anti-cyclones influence the formation of clouds and fog.
3. During summer, anti-cyclones tend to influence the occurrence of warm, dry and sunny weather
4. Temperature inversion occurs especially in the cold anti-cyclone when we have fog and smog.
5. Anti-cyclones are associated with descending air which is warmed adiabatically. This results in very little or no rainfall in summer because subsiding air is unfavorable for cloud formation.
6. At night anti-cyclones are associated with radiation surfaces are associated with radiation surface cooling which leads to development of fog.
7. Hazy conditions are associated with anti-cyclones due to the blowing of cold anti-cyclones over the Sahara towards the low latitudes.

Questions

- a) What is an anti-cyclone?

Approach

- ❖ Define anti-cyclone
 - ❖ Give the characteristics and where they occur
- b) Describe the weather characteristics associated with anticyclones

Approach

Explain the effects of anti-cyclones on weather. Show the kinds of weather conditions that occur due to anti-cyclones

Questions

Differentiate between depression (cyclones) and anti-cyclones

1. In a depression (cyclone) there is low pressure at the center which increases outwards

However, in an anticyclone there is high pressure at the center which decreases outwards.

2. Cyclones/depressions affect a small area where as anti-cyclones affect large areas e.g. the whole continent.
3. In a cyclone winds blow at a very fast speed
4. Cyclones develop from ocean surface and then move towards land.
5. Cyclones are always on the run where as anti-cyclones may remain stationary.
6. In the northern hemisphere, the air circulation in a cyclone is in the anti-clockwise direction

However, air circulation in anti-cyclones in the northern hemisphere is in clockwise direction.

7. In the southern hemisphere, the air circulation in cyclones is in the clockwise direction

Whereas the air circulation in an anti-cyclone is in anti-clockwise direction in the southern hemisphere.

8. Cyclones are characterized by violent weather cumulo-nimbus clouds, heavy rainfall, and gusty wind.

However, anti-cyclones are characterized by calm weather conditions i.e. sunny, light clouds, fog.

Question

With reference to specific examples, examine the effects of tropical cyclones on the areas they occur.

Approach

- ❖ Define tropical cyclones
- ❖ Give types (different names) e.g. willy-willies etc.
- ❖ Give characteristics of tropical cyclones
- ❖ Give their effects on both weather and human activities.

EFFECTS ON WEATHER

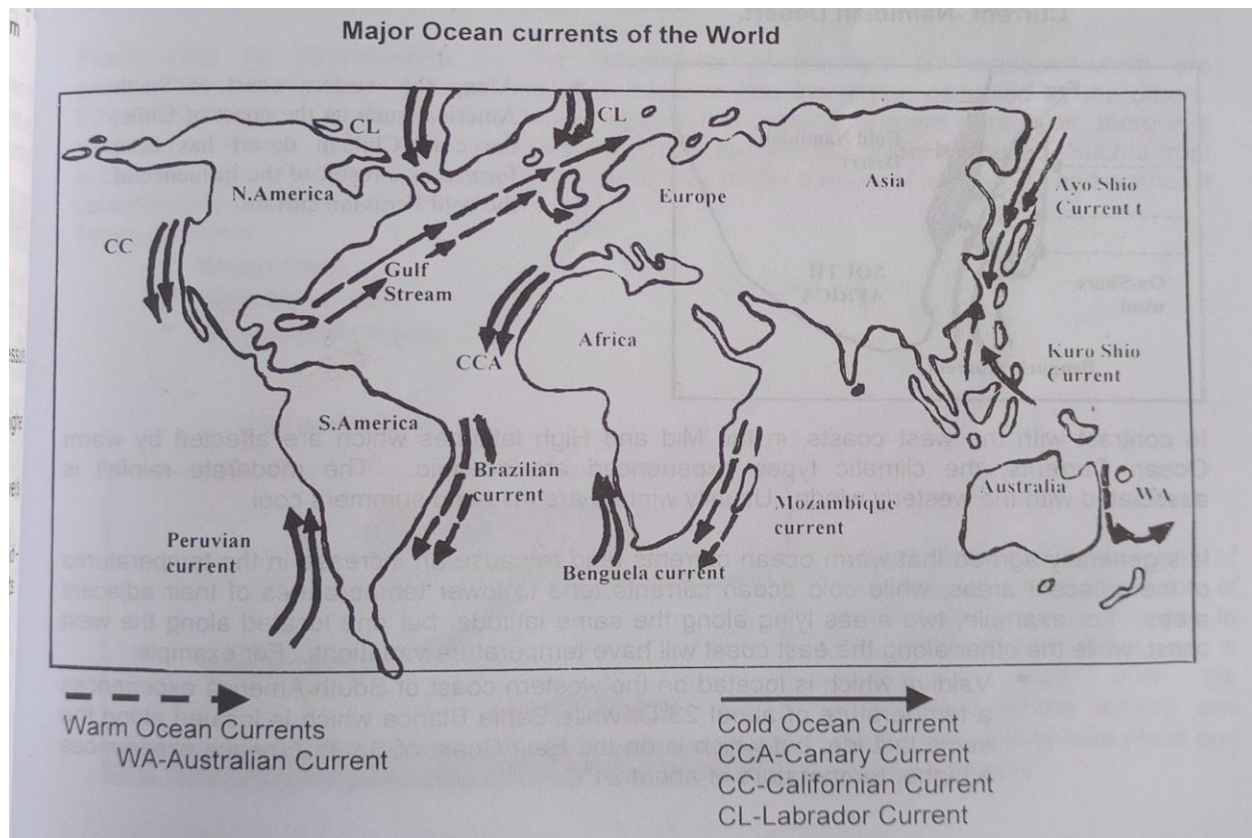
- ❖ Cyclones are associated with gusty winds i.e. strong, fast and destructive winds e.g. tornadoes can blow at a speed of 500km/hr.
- ❖ They result into heavy rainfall characterized by thunder and lightning.
- ❖ Result into reduced visibility due to thick clouds, fast winds and torrential rains.
- ❖ Cyclones are associated with high temperatures of over 27⁰C leading to convective instability and formation of dense cumulo-nimbus.
- ❖ They are associated with humidity and high temperatures.
- ❖ They are associated with sudden appearance of calm, clear and dry conditions with the advance of the “eye” and then violent conditions.

EFFECTS ON HUMAN ACTIVITIES

1. Cyclones are associated with violent winds which blow up settlements, ships, infrastructure like electricity lines, roads e.g. in India, Bangladesh among others.
2. Strong winds lead to loss of livestock, crops, and human lives (through suffocation and debris brought by gusty winds).
3. Cyclones result into flooding of coastal islands and towns e.g. of New Orleans and Florida are usually flooded.
4. Cyclones are associated with outbreak of water borne diseases e.g. cholera among others due to floods. This is common in India, Bangladesh.
5. Cyclones lead to food shortages (famine) because they destroy crops, animals etc.

OCEAN CURENTS

An ocean current is the general movement of surface water in the ocean in a fairly defined direction.



CHARACTERISTICS OF OCEAN CURRENTS

1. Their flow is persistent i.e. they flow from one part of the ocean to another.
2. They vary in temperatures i.e. they are either cold or warm ocean currents.
3. Within the low latitudes, warm ocean currents flow along the eastern side of the land masses and cold ocean currents flow along the western side of the land masses.
4. Within the middle and high latitudes, warm ocean currents flow along the western side of the land masses e.g. the North Atlantic drift in Europe. On the other hand cold ocean currents flow on the eastern side of the land masses in the high latitudes e.g. the cold Oyasio current on the eastern side of Asia, and the cold Labrador Current on the eastern side of North America.
5. In the northern hemisphere (except for Indian Ocean), ocean currents circulate in a clockwise direction though some currents are deflected in the equatorial belt due to the

earth' rotation. On the other hand, in the southern hemisphere, ocean currents circulate in an anti-clockwise direction.

6. Warm ocean currents are characterized by high salinity levels while cold ocean currents have low salinity levels.

CAUSES OF OCEAN CURRENTS

1. Winds (prevailing winds)

Winds generate friction on the ocean water surface causing a thin layer of top ocean water to move in the general direction of the wind. For example in the Atlantic Ocean, ocean currents are driven by the North East and south east trade winds.

2. Rotation of the earth

As the earth rotates on its axis it generates a drag force called Coriolis force.

According to this force any object flowing is deflected to its right in the Northern hemisphere and to its left in the southern hemisphere.

This force compels water to drift towards a clockwise direction (right) in the northern hemisphere and also deflects water to move in an anticlockwise (left) in the southern hemisphere.

3. Differences in temperatures

Ocean currents caused by differences in temperature are called convectional currents. The water near the equator is warm and therefore less dense than that at the poles. As a result convectional currents are set up.

Warm water from the equatorial regions flows towards the poles where it is cooled, while cold water from the poles flows towards the equatorial region.

4. Difference in salinity/density of ocean waters.

Salinity refers to the amount of salt in the ocean water. Ocean waters usually contain dissolved minerals e.g. salts, magnesium, potassium etc.

Water with a high salinity content flows to water with a less salinity content hence leading to ocean currents. E.g. water drifts from Mediterranean Sea to Atlantic Ocean because the sea has higher salinity content.

5. **Tides:** The sun and the moon exert a gravitational attraction on the earth's surface. This results into high and low tides depending on the extent of the gravitational pull which consequently result into movement of ocean waters hence ocean currents.

TYPES OF OCEAN CURRENTS

There are **2** types of ocean currents i.e. warm and cold ocean currents:

a) WARM OCEAN CURRENTS

A warm ocean current is one which has a relatively higher temperature than the surrounding areas.

The warm ocean currents that affect the African coastline include:

- ❖ Warm Mozambique (Agulhas) ocean current which washes the south-eastern part of Africa.

They are driven by the south east trade winds and bring warm temperatures and rainfall along the southeast coast of Africa.

- ❖ Warm Guinea current

This warm current washes the West African coast. It raises temperature and rainfall along the West African coast.

CHARACTERISTICS OF WARM OCEAN CURRENTS

1. They have warm temperatures e.g. Mozambique current which flows along the eastern African continent.
2. They move from regions of relatively warmer temperatures to regions of cooler temperatures.
3. Warm ocean currents move from lower latitudes (equatorial regions) to the higher latitudes (poles).
4. Warm ocean currents are found mainly on the eastern sides of continents in low latitudes e.g. the Mozambique, Brazilian, Kuroshio and East Australian currents.
5. In the middle latitudes warm ocean currents are also found on the western coasts e.g. North Atlantic drift along the coast of Western Europe. (that's UK, Norway, Sweden, Denmark)
6. They are characterized by high alkalinity or low density.
7. They lose temperature as they flow on the surface towards the poles.
8. Warm ocean currents mostly circulate in a clockwise direction in the northern hemisphere e.g. north pacific drift in the pacific ocean while in the southern hemisphere their circulation is in an anti-clockwise direction e.g. Mozambique and east Australian currents.

b) COLD OCEAN CURRENTS

A cold ocean current is one which has a relatively colder temperature than the surrounding areas.

The cold ocean currents which affect African coastline include:

- ❖ **The Benguela current.** This cold ocean current in the Atlantic Ocean flows along the coast of south West Africa and because of its coldness, it lowers the temperature of the adjacent coastlands i.e. Namibia and Botswana.
- ❖ **The Canary currents.** This is a cold current off the coast of Northwest Africa in the Atlantic Ocean. It lowers the temperature of the adjacent land masses for example Morocco, etc.

CHARACTERISTICS OF COLD OCEAN CURRENTS

1. They have cold temperatures e.g. the canary current along the Moroccan coast.
2. They move from regions of relatively lower temperatures to regions of relatively higher temperatures.
3. Cold currents move from higher latitudes i.e. Benguela and canary currents in the Atlantic Ocean.
4. They mainly flow on the western sides of continents in low latitudes e.g. Benguela and canary currents.
5. In the middle latitudes, cold ocean currents flow along the eastern coasts e.g. Labrador Current along the eastern Canadian coast.
6. They gain temperature as they flow on the surface towards the equator.
7. They circulate in clockwise direction in the Northern hemisphere e.g. Canary and California currents while in the southern hemisphere they circulate in an anti-clockwise direction e.g. Benguela and Peruvian currents.

EFFECTS OF OCEAN CURRENTS ON CLIMATE

Warm and cold ocean currents affect the climate of the adjacent areas in different ways:

a) EFFECTS OF WARM OCEAN CURRENTS ON CLIMATE

1. Warm ocean currents raise temperature of adjacent lands. This is because warm ocean currents raise the temperature of winds blowing over them which is then transferred to adjacent areas raising the temperature of such areas e.g. the warm Mozambique current raises the temperatures of Mombasa, Dar-es-salaam, and Durban etc.

2. They raise humidity levels of the adjacent lands. This is because the ocean surfaces where the warm ocean currents originate are warm and moist therefore the high temperatures encourage high evaporation rates leading to increased amount of water vapour in the atmosphere above the ocean resulting into high humidity levels in the adjacent areas.
3. Warm ocean currents cause thick cloud cover over the adjacent land masses.

As winds blow over the warm ocean currents, they absorb the moisture over the current and become moisture-laden.

When these winds reach the shore, they are cooled and condensed to form massive clouds e.g. cumulo-nimbus clouds along the Eastern African coast.

4. They lead to formation of heavy rainfall in the adjacent lands when winds are onshore. This is because the winds blowing over the warm ocean currents will have picked much moisture over the oceans. On crossing the heated land surface, heavy rainfall results e.g. warm Mozambique current cause heavy rainfall along the Eastern African coast.

b) EFFECTS OF COLD OCEAN CURRENTS ON CLIMATE

Cold ocean current influence climate in the following ways:

1. They lower the temperatures of the adjacent lands where they blow to. This is because cold ocean currents are driven by cool winds which in turn lower the temperature of the adjacent lands over which they blow e.g. the cold Benguela current flowing northwards along the coast of Namibia lowers the temperatures here.
2. They cause low humidity in the adjacent areas. This is because as the winds blow over them, their temperature is lowered hence reducing their capacity to absorb moisture resulting into low humidity e.g. the cold canaries along the coast of Morocco.
3. They lead to low cloud cover over the adjacent land masses. As winds blow over the cold ocean currents, their temperature is lowered and hence absorb very little moisture resulting in them being dry winds. When these winds reach the shore, they are cooled and slight condensation occurs leading to formation of scanty clouds and clear skies e.g. Benguela current along the coast of Namibia and Angola.
4. Cold ocean currents lead to formation of low rainfall in the adjacent lands when the winds blow onshore. This is because the winds blowing over them pick little moisture because of the reduced temperatures. On crossing the heated and surface, little

condensation occurs and low rainfall is received e.g. cold Benguela current is responsible for the low rainfall along the coast of Namibia and Angola.

5. Cold currents e.g. Benguela currents lead to formation of advection fog along the coastline, affecting visibility. Advection fog is formed when warm moist air blows over cold ocean surface.

Question 1a)

What are ocean currents?

- ❖ Define ocean currents
- ❖ Explain the causes of ocean currents
- ❖ Identify the types of ocean currents
- ❖ Describe characteristics of ocean currents

b) Explain the influence of ocean currents on climate of Africa

- ❖ Identify the different ocean currents (both warm and cold currents) that influence the climate of Africa
- ❖ Explain the influence on climate of warm ocean currents and cold ocean currents

Question 2a)

Describe the characteristics of a cold ocean current.

- ❖ Approach
- ❖ Define ocean currents
- ❖ Describe characteristics of cold ocean currents

b) With reference to specific examples explain the influence of cold ocean currents on the climate of adjacent land masses.

- ❖ Explain the influence of cold ocean currents on adjacent areas.

EFFECTS OF OCEAN CURRENTS ON HUMAN ACTIVITIES

a) EFFECTS OF WARM OCEAN CURRENTS ON HUMAN ACTIVITIES:

1. The resultant rainfall due to warm ocean currents has encouraged crop cultivation (farming). For example sisal and cloves are grown along the East African coast while in South Africa sugarcane is grown at Natal province due to heavy rains caused by warm Mozambique Ocean current.

Guinea current also favours the growth of rubber, cocoa and palm oil in Liberia.

2. Forestry and lumbering activities are favoured by the warm currents. For instance the warm Mozambique current due to heavy rainfall associated with it, has led to growth of mangrove forests along the coast of Tanzania and Kenya. Also heavy rainfall formed by warm Guinea current has led to growth of thick tropical forests in Liberia, Gabon, and Nigeria etc.
3. Mining activities have also developed due to the influence of ocean currents. The warm Mozambique currents bring high temperatures favorable for coral growth at the coast of East Africa e.g. at Mombasa etc. In Kenya and Tanzania (at Tanga) corals are mined and processed to produce cement at Bamburi and Tanga cement industries.
4. Tourism has also been promoted at Mombasa, Malindi and Dar-es-salaam due to influence of warm Mozambique ocean currents.

Besides coral rocks formed, warm currents are associated with high temperatures favorable for sun bathing, swimming and game fishing hence attracting tourists from cold countries e.g. Canada, USA etc.

5. Heavy rainfall formed by warm Mozambique current has attracted settlements along the coast of Mombasa, Dar-es-salaam etc.

b) EFFECTS OF COLD OCEAN CURRENTS ON HUMAN ACTIVITIES

1. Cold ocean currents cause up-welling of ocean waters creating conducive conditions for the development of planktons hence encouraging fishing activities like fishing at the coast of Namibia has been partly influenced by cold Benguela currents.
2. Cold ocean currents create arid conditions in the adjacent land masses, such conditions lead to scarcity of water and pastures forcing nomads to roam over wide areas in search of water for their animals. Nomadic pastoralism is dominant in Sahara desert partly due to influence of cold canary currents.
3. Cold ocean currents lead to the development of off-shore foggy conditions which reduce visibility and hence affect navigation. For example along the Atlantic navigation is sometimes hindered by fog caused by cold Benguela currents.

Question (1)

- a) Describe the characteristics of warm ocean currents
- b) Explain the influence of ocean currents on human activities

Question 2)

Giving specific examples, examine the influence of ocean currents on the economic activities along the coastal regions of Africa.