Notes

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11

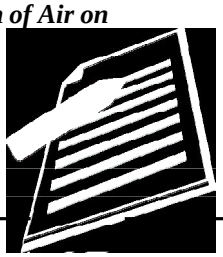
PRESSURE AND WINDS

We do not ordinarily think of air as having too much weight. But air has weight and it exerts pressure. Let us take an empty bicycle tube and weight it. Now fill tube with air and weight it again. You will find that the weight of the air filled tube is more than when it was empty. If you go on filling air in the tube a situation comes when the tube bursts. The bursting of the tube occurs due to increase in air pressure in the tube. Similarly, the air around us exerts pressure. But we do not feel the weight of the atmosphere because we have air inside us which exerts an equal outward pressure that balances the inward pressure of the atmosphere. Atmospheric pressure is important to us because it is related to winds and it helps to determined, weather conditions of a place. In this lesson you will study air pressure, its distribution, winds and their types.

OBJECTIVES

After studying this lesson, you will be able to :

- give reasons for the decrease of air pressure with increase in altitude;
- describe with examples the effect of low air pressure at high altitude on the daily life of man;
- explain the relationship between the spacing of isobar and pressure gradient;
- establish relationship between the temperature and the existence of equatorial low pressure and the polar high pressure;
- give reason for the existence of sub-tropical high pressure and sub-polar low pressure belts;
- explain the distribution of atmospheric pressure with the help of isobar maps of the world for the months of January and July;



- establish the relationship between pressure gradient and speed of winds
- explain the influence of coriollis effect on the direction of winds of both the hemispheres;
- draw diagram showing pressure belts and planetary winds;
- distinguish between (a) planetary and monsoon winds (b) land and sea breezes (c) valley and mountain breezes and (d) cyclones and anti-cyclones:
- describe the characteristics of Important local winds

11.1 MEASUREMENT OF AIR PRESSURE

The atmosphere is held on the earth by the gravitational pull of the earth. A column of air exerts weight in terms of pressure on the surface of the earth. The weight of the column of air at a given place and time is called air pressure or atmospheric pressure. Atmospheric pressure is measured by an instrument called barometer. Now a days Fortin's barometer and Aneroid barometer I are commonly used for measuring air pressure.

Atmospheric pressure is measured as force per unit area. The unit used for measuring pressure is called millibar. Its abbreviation is 'mb'. One millibar is equal to the force of one gram per square centimetre approximately. A pressure of 1000 millibars is equal to the weight of 1.053 kilograms per square centimetre at sea level. It is equal to the weight of a column of mercury which is 76 centimetre high. The international standard pressure unit is the "pascal", a force of one Newton per square meter. In practice atmospheric pressure is expressed in kilopascals, (one kpa equals 1000 Pa).

- The weight of a column of air at a given place and time is called air pressure.
- Barometer is the instrument which measures air or atmospheric pressure.
- The unit of measurement of atmospheric pressure is millibar (kilopascals).
- One millibar is equal to the force of nearly one gram per square centimetre.

The mean atmospheric pressure at sea level is 1013.25 millibars. However the actual pressure at a given place and at a given time fluctuates and it generally ranges between 950 and 1050 millibars

11.2 DISTRIBUTION OF AIR PRESSURE

Distribution of atmospheric pressure on the surface of the earth is not uniform. It varies both vertically and horizontally.

(a) Vertical Distribution

Air is a mixture of various gases. It is highly compressible. As it compresses, its density increases. The higher the density of air, the greater is the air pressure and vice versa. The mass of air above in the column of air compresses the air under it hence its lower layers are more dense than the upper layers; As a result, the lower layers of the atmosphere have higher density, hence, exert more pressure. Conversely, the higher layers are less compressed and, hence, they have low density and low pressure. The columnar distribution of atmospheric pressure is known as vertical distribution of pressure. Air pressure decreases with increase in altitude but it does not always decrease at the same rate. Dense components of atmosphere are found in its lowest parts near the mean sea level. Temperature of the air, amount of water vapour present in the air and gravitational pull of the earth determine the air pressure of a given place and at a given time. Since these factors are variable with change in height, there is a variation in the rate of decrease in air pressure with increase in altitude. The normal rate of decrease in air pressure is 34 millibars per every 300 metres increase in altitude; (see figure 11.1). The effects of low pressure are more clearly experienced by the people living in the hilly areas as compared to those who live in plains. In high mountainous areas rice takes more time to cook because low pressure reduces the boiling point of water. Breathing problem such as faintness and nose bleedings are also faced by many trekkers from outside in such areas because of low pressure conditions in which the air is thin and it has low amount of oxygen content.

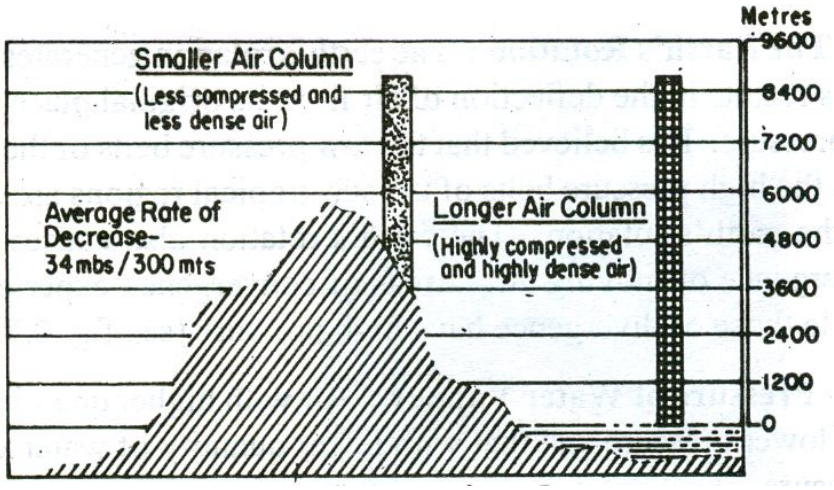
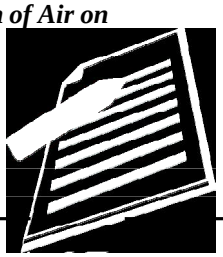


Fig 11.1 Vertical Distribution of Air Pressure

(b) Horizontal Distribution

The distribution of atmospheric pressure over the globe is known as horizontal distribution of pressure. It is shown on maps with the help of isobars. An isobar is a line connecting points that have equal values of pressure. Isobars are analogous to the contour lines on a relief map. The spacing of isobars expresses the rate and direction of change in air pressure. This charge in air pressure is referred to pressure gradient. Pressure gradient is the ratio between



pressure difference and the actual horizontal distance between two points. Close spacing of isobars expresses steep pressure gradient while wide spacing indicates gentle pressure gradient (see fig. 11.5)

The horizontal distribution of atmospheric pressure is not uniform in the world. It varies from time to time at a given place; it varies from place to place over short distances. The factors responsible for variation in the horizontal distribution of pressure are as follows:

(i) Air temperature

(ii) The earth's rotation

(iii) Presence of water vapour

(i) Air Temperature: In the previous lesson, we have studied that the earth is not heated uniformly because of unequal distribution of insolation, differential heating and cooling of land and water surfaces. Generally there is an inverse relationship between air temperature and air pressure. The higher the air temperature, the lower is the air pressure. The fundamental rule about gases is that when they are heated, they become less dense and expand in volume and rise. Hence, air pressure is low in equatorial regions and it is higher in polar regions. Along the equator lies a belt of low pressure known as the "equatorial low or doldrums". Low air pressure in equatorial regions is due to the fact that hot air ascends there with gradual decrease in temperatur causing thinness of air on the surface. In polar region, cold air is very dense hence it descends and pressure increases. From this we might expect, a gradual increase in average temperature thords equator. However, actual readings taken on the earth's surface at different places indicate that pressure does not increase latitudinally in a regular fashion from equator to the poles. Instead, there are regions of high pressure in subtropics and regions of low pressure in the subpolar areas.

(ii) The Earth's Rotation: The earth's rotation generates centrifugal force. This results in the deflection of air from its original place, causing decrease of pressure. It is believed that the low pressure belts of the sub polar regions and the high pressure belts of the sub-tropical regions are created as a result of the earth's rotation. The earth's rotation also causes convergence and divergence of moving air. Areas of convergence experience low pressure while those of divergence have high pressure (see fig. 11.7).

(iii) Pressure of Water Vapour : Air with higher quantity of water vapour has lower pressure and that with lower quantity of water vapour has higher pressure. In winter the continents are relatively cool and tend to develop high pressure centres; in summer they stay warmer than the

oceans and tend to be dominated by low pressure, conversely, the oceans are associated with low pressure in winter and high pressure in summer.

- An isobar is a line connecting points that have equal values of pressure.
- Pressure gradient is the ratio between pressure difference and horizontal distance between two points.
- On an average air pressure decreases by 34 millibars per 300 metres increase in height.

INTEXT QUESTIONS 11.1

1. Name the three factors which influence horizontal distribution of air pressure:

   (a)_____(b)_____(c)_____

2. Name the two instruments used to measure air pressure:

   (a)_____(b)_____

3. What is the mean atmospheric pressure at sea level?

   _____

4. Select the best alternative for each and mark tick (√) on it :

   (a) A pressure of 1000 millibars is equal to the weight of a column of mercury having height of

   (i) 65 cm; (ii) 70 cm; (iii) 76 cm; (iv) 80cm

   (b) Areas where moving air converge have

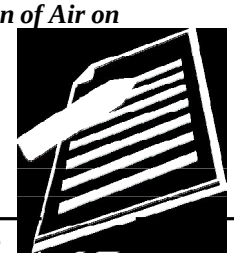
   (i) high pressure. (ii) low pressure; (iii) both high and low pressure (iv) no pressure at all

   (c) Air with lower quantity of water vapour has (i) higher pressure (ii) lower pressure; (iii) no pressure (iv) none of the above

11.3 PRESSURE BELT

The horizontal distribution of air pressure across the latitudes is characteriesd by high or low pressure belts. This is however, a theoretical model because pressure belts .are not always found as such on the earth. We will see it later how the real condition departs from the idealized model. and examine why these differences occur.

These pressure belts are: (i) The Equatorial Low Pressure Belt;. (ii) The Sub



tropic High Pressure Belts; (iii) The Sub-polar Low Pressure Betts; (iv) The Polar High Pressure Belts (see fig. 11.2)

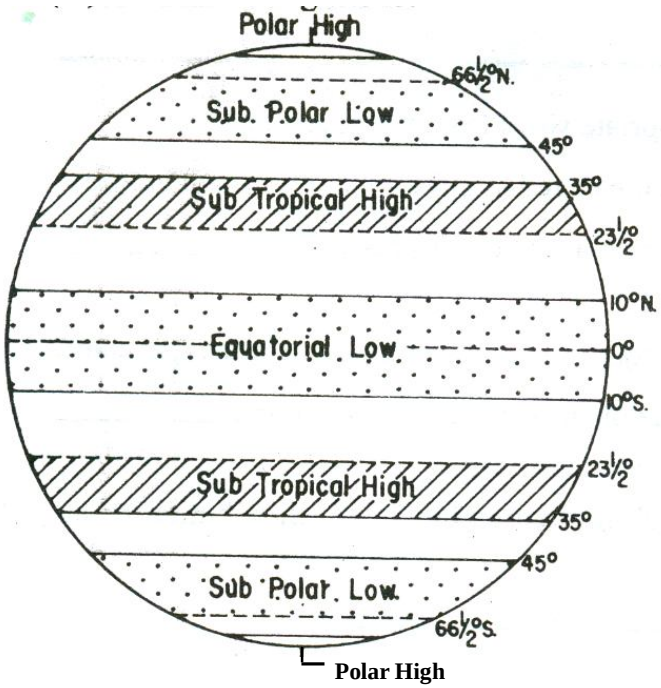


Fig. 11.2 Pressure Belts

(i) The Equatorial Low Pressure Belt

The sun shines almost vertically on the equator throughout the year. As a result the air gets warm and rises over the equatorial region and produce equatorial low pressure. This belt extends from equator to 10^0N and 10^0S latitudes. Due to excessive heating horizontal movement of air is absent here and only conventional currents are there. Therefore this belt is called doldrums (the zone of calm) due to virtual absence of surface winds. These are the regions of convergence because the winds flowing from sub tropical high pressure belts converge here. This belt is also known as-Inter Tropical Convergence Zone (ITCZ).

(ii) The Sub-tropical High Pressure Belts

The sub-tropical high pressure belts extend from the tropics to about 35^0 latitudes in both the Hemispheres. In the northern hemisphere it is called as the North sub-tropical high pressure belt and in the southern hemisphere it is known as the South sub-tropical high pressure belt. The existence of these pressure belts is due to the fact that the up rising air of the equatorial region is deflected towards poles due to the earth's rotation. After becoming cold and heavy, it descends in these regions and get piled up. This results in high pressure. Calm conditions with feeble and variable winds are found here. In olden days vessels with cargo of horses passing through these belts found difficulty in sailing under these calm conditions. They used to throw the horses in the sea in order to make the vessels lighter. Henceforth these belts

or latitudes are also called 'horse latitudes'. These are the regions of divergence because winds from these areas blow towards equatorial and sub-polar low pressure belts.

(iii) The Sub-polar low Pressure Belts

The sub-polar low pressure belts extend between 45^0N and the Arctic Circle in the northern hemisphere and between 45°S and the Antarctic Circle in the southern hemisphere. They are known as the North sub-polar low and the South sub-polar low pressure belts respectively. Winds coming from the sub-tropical and the polar high belts converge here to produce cyclonic storms or low pressure conditions. This zone of convergence is also known as polar front.

(iv) The Polar High Pressure Belts

In polar regions, sun never shines vertically. Sun rays are always slanting here resulting in low temperatures. Because of low temperature, air compresses and its density increases. Hence, high pressure is found here. In northern hemisphere the belt is called the North polar high pressure belt while it is known as the South polar high pressure belt in the southern hemisphere. Winds from these belts blow towards sub-polar low pressure belts.

This system of pressure belts that we have just studied is a generalised picture. In reality, the location of these pressure belts is not permanent. They shift northward in July and southward in January, following the changing position of the sun's direct rays as they migrate between the Tropics of Cancer and Capricorn. The thermal equator (commonly known as the belt of highest temperature) also shifts northwards and southwards of the equator. With the shifting of thermal equator northwards in summer and southwards in winter, there is also a slight shift in pressure belts towards north and south of their annual average location.

- Sub-tropical high pressure belts are also called horse latitudes.
- Subsidence and piling of air in sub-tropical belts cause high pressure.
- Convergence of subtropical and polar winds result in the formation of cyclones in the sub-polar regions.
- High pressure belts are dry while low pressure belts are humid.
- With the movement of sun northwards and southwards thermal equator also shifts northwards and southwards.
- Pressure belts also shift northwards and southwards with the shift of thermal equator.

11.4 SEASIONAL DISTRIBUTION OF PRESSURE

The variation of pressure from place to place and from season to season over the earth plays an important role in affecting the weather and climate. Therefore we study pressure distribution through isobar maps. While drawing isobar maps, the pressures of all places are reduced to sea level to avoid the effect of altitude on air pressure.

(i) January Conditions

In January, with the south-ward apparent movement of the Sun, the equatorial low pressure belt shifts a little south of the mean equatorial position (see fig. 11.3). Areas of lowest pressure occurs in South America, Southern Africa and Australia. This is because the land tends to get hotter rapidly than water. Sub-tropical high pressure cells are centered over the ocean in the southern hemisphere. The belt of high pressure is interrupted by the continental land masses where the temperature is much higher. They are well developed in eastern part of the ocean where cold ocean currents dominate.

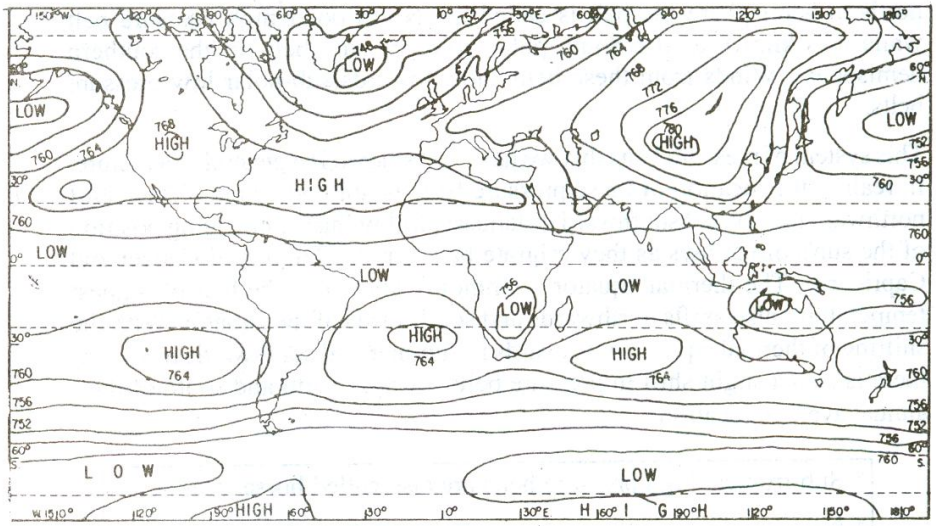


Fig. 11.3 Distribution of Air Pressure (January)

In the northern hemisphere, ridges of high pressure occur in the sub-tropical latitudes over the continent. A well developed high pressure cell occurs in the interior parts of Eurasia. This is due to the fact that land cools more rapidly than oceans. Its temperatures are lower in winter than the surrounding seas. In the southern hemisphere, the sub-polar low pressure belt circles the earth as a real belt of low pressure and is not divided into cells, because there is virtually no landmass. In northern hemisphere two cells of low pressure namely Iceland low and Aleutian low develop over the North Atlantic and the North Pacific oceans respectively.

(ii) July Conditions

In July, the equatorial low pressure belt shifts a little north of the mean

equatorial position because of the northward apparent movement of the Sun. All the pressure belts shift northwards in July. (see fig. 11.4)

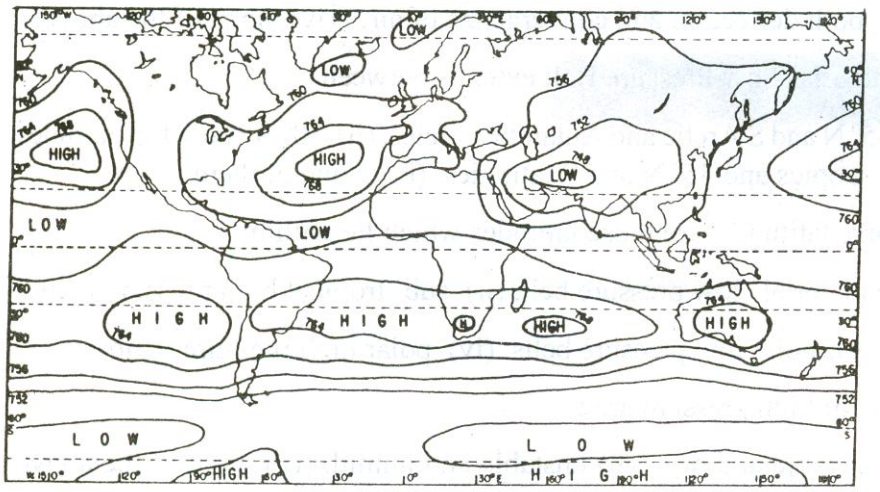


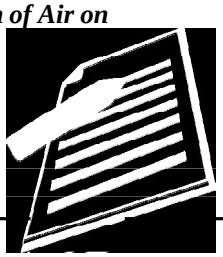
Fig. 11.4 Distribution of Air Pressure (July)

The Aleutian and Icelandic lows disappear from the oceans while the landmasses, which developed high pressure during winter months, have extensive low pressure cells now. In Asia, a low pressure develops. The sub-tropical hights of the northern hemisphere are more developed over the oceans - Pacific and Atlantic. In the southern hemisphere, the sub-tropical high pressure belt is continuous. Sub-polar low forms a continuous belt in the southern hemisphere while in northern hemisphere, there is only a faint oceanic low.

INTEXT QUESTION 11.2

1. Complete each of the following with suitable endings:
   (a) The belt of highest temperature is known as_____
   (b) In drawing isobar maps the factor eliminated is that of _____
   (c) Higher the density of air, higher is its _____
   (d) Higher the temperature of air, lower is its_____
2. Select the best alternatives for each of the following:
   (a) Earth's rotation causes:

   (i) deflection of air from its original direction.(ii) convergence of air. (iii) both deflection and convergence of air. (iv) none of the above.



(b) Equatorial Low Pressure Belt extends between:

(i) 45° N and S Arctic and Antarctic Circles. (ii) 10° N and 10° S latitudes. (iii) tropics and 35° N and S latitudes. (iv) none of them.

(c) 'Horse latitudes' are those latitudes which lie within:

(i) equatorial low pressure belt. (ii) sub- tropical high pressure belts. (iii) sub-polar low pressure belts. (iv) polar high pressure regions.

(d) Belts of high pressure are:

(i) unstable and dry. (ii) unstable and humid. (iii) both of the above. (iv) none of the above.

11.5 WINDS

We have just studied that air pressure is unevenly distributed. Air attempts to balance the uneven distribution of pressure. Hence, it moves from high pressure areas to low pressure areas. Horizontal movement of air in response to difference in pressure is termed as wind while vertical or nearly vertical moving air is called air current. Both winds and air currents form the system of circulation in the atmosphere.

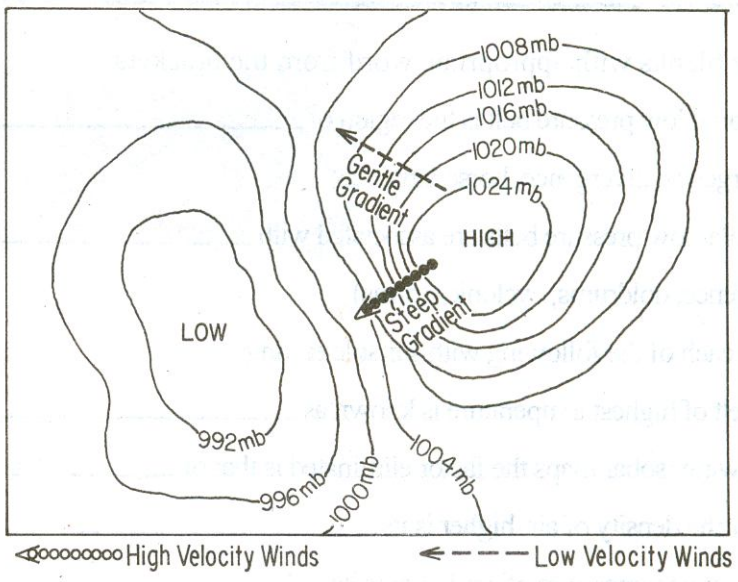


Fig. 11.5 Relationship between Pressure Gradient and Winds

(i) Pressure Gradient and Winds

There is a close relationship between the pressure and the wind speed. The greater the difference in air pressure between the two points, the steeper is the pressure gradient and greater is the speed of the wind. The gentler the pressure gradient slower is the speed of the wind. (see fig. 11.5).

(ii) The Coriolis Effect and Wind

Winds do not cross the isobars at right angles as the pressure gradient directs them. They get deflected from their original paths. One of the most potent influences on wind direction is the deflection caused by the earth's rotation on its axis. Demonstrated by Gaspaved de Coriolis in 1844 and known as the Coriolis effect or coriolis force. Coriolis force tend to deflect the winds from there original direction. In northern hemisphere winds are deflected towards their right, and in the southern hemisphere towards their left (see fig. 11.6) This is known as Farrel's law. The Coriolis force is absent along the equator but increases progressively towards the poles.

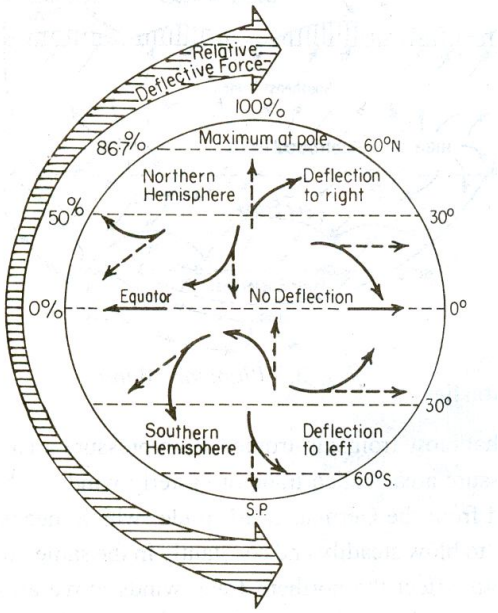


Fig. 11.6 Deflection of Winds by Coriolis Force

11.6 TYPE OF WINDS

For ages man has observed that in some areas of the earth the winds blow predominantly from one direction throughout the year; in other areas the wind direction changes with the season and in still others the winds are so variable that no pattern is discernible. Despite these difference, the winds are generalized under three categories.

(a) planetary winds or permanent winds

(b) periodic winds and

(c) local winds

(a) Planetary Winds

Planetary or permanent winds blow from high pressure belts to low pressure belts in the same direction throughout the year. They blow over vast area of

continents and oceans. They are easterly and westerlies and polar easterlies. (see fig. 11.7)

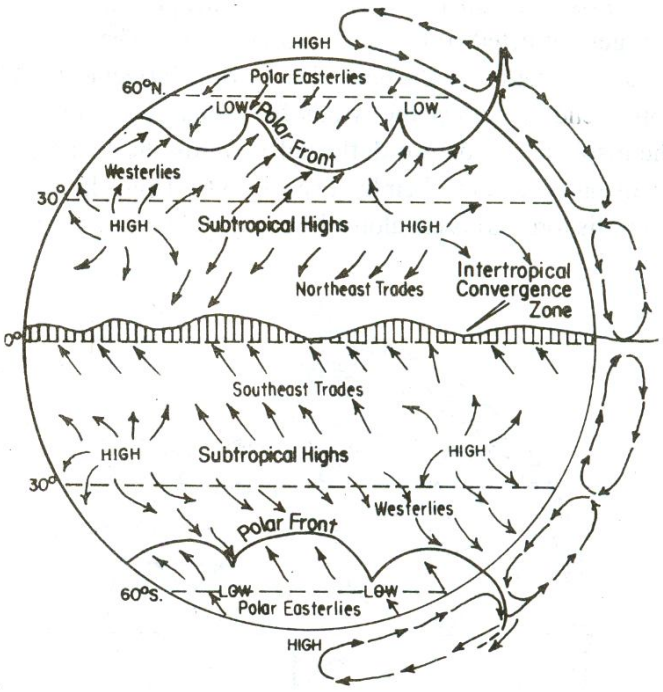


Fig 11.7 : Planetary Winds

(i) The Easterlies

The winds that blow from sub-tropical high pressure areas towards equatorial low pressure areas called trade or easterly winds: The word trade has been derived from the German word 'trade' which means track. To blow trade means 'to blow steadily and constantly in the same direction'. Because of the Coriolis effect the northern trade winds move away from the sub-tropical high in north-east direction. In southern hemisphere the trade winds diverge out of the sub-tropical high towards the equatorial low from the south-east direction As the trade winds tend to blow mainly from the east, they are also known as the Tropical easterlies. (see fig. 11.7)

(ii) The Westerlies

The winds that move poleward from the sub-tropical high pressure in the northern hemisphere are detected to the right and thus blow from the south west. These in the southern hemisphere are deflected to the left and blow from the north-west. Thus, these winds are called westerlise (see fig. 11.7)

(iii) Polar Easterlies

Polar easterlies blow from polar regions towards sub-polar low pressure regions. Their direction in the northern hemisphere is from north-east to south-west and from south-east to north-west in the southern hemisphere.

- In northern hemisphere winds, are deflected towards their right and in the southern hemisphere towards their left. This is known as Ferrel's law.

INTEXT QUESTIONS 11.3

1. Name Planetary winds:

   (a) _____(b)_____(c)_____

2. What is Ferrel's law?

   _____

3. Choose the correct alternative for each of the following:

   (a) Winds blow from high pressure to

   (i) low pressure, (ii) high pressure, (iii) both low and high pressures (iv) none of them.

   (b) Winds are deflected from their original path due to

   (i) Coriolis effect, (ii) pressure gradient, (iii) their speed, (iv) high pressure

   (c) Winds are caused primarily by

   (i) Coriolis effect, (ii) pressure difference (iii) rotation of the earth, (iv) humidity difference.

   (d) The Coriolis force at the equator is

   (i) maximum, (ii) medium, (iii) nil, (iv) none of the above.

(b) Periodic Winds

The direction of these winds changes with the change of seasons. Monsoon winds are the most important periodic winds.

Monsoon Winds

The word 'Monsoon' has been derived from the Arabic word 'Mausim' meaning season. The winds that reverse their direction with the change of seasons are called monsoon winds. During summer the monsoon winds blow from sea towards land and during winter from land towards seas. Traditionally these winds were explained as land and sea breezes on a large scale. But this explanation does not hold good now. Now a days the monsoon is generally accepted as seasonal modification of the general planetary wind system. The Asiatic monsoon is the result of interaction of both planetary wind system

and regional factors, both at the surface and in the upper troposphere (see fig. 11.8)

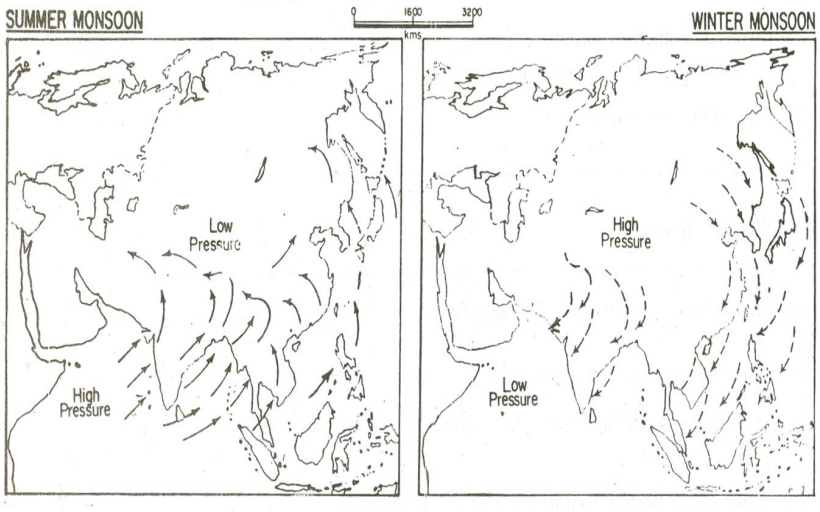


Fig. 11.8 The Monsoon Winds

India, Pakistan, Bangladesh, Myanmar(Burma), Sri Lanka, the Arabian Sea, the Bay of Bengal, South-east Asia, North Australia, China and Japan are important regions where monsoon winds are prevalent.

- Winds which reverse their direction with the change of seasons are called monsoons.

(c) Local Winds

Till now we were discussing the major winds of the earth's surface, which are vital for understanding the climatic regions. But we are all aware that there are winds that affect local weather. Local winds usually affect small areas and are confined to the lower levels of the troposphere. Some of the local winds are given below :

(i) Land and Sea Breezes

Land and sea breezes are prevalent on the narrow strips along the coasts or a lake. It is a diurnal (daily) cycle, in which the differential heating of land and water produces low and high pressures. During the day when landmass gets heated more quickly than the adjoining sea or large lake; air expands and rises. This process produces a local low pressure area on land. Sea breeze then develops, blowing from the water (high pressure) towards the land (low pressure). The sea breeze begins to develop shortly before noon and generally reaches its greatest intensity during mid-day to late afternoon. These cool winds have a significant moderating influence in coastal area.

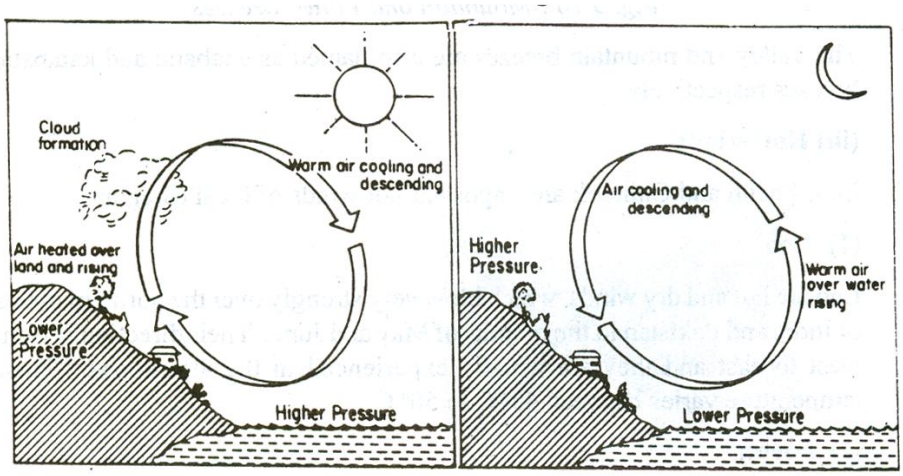


Fig 11.9 Sea and Land Breezes

At night, the land and the air above it cools more quickly than the nearby water body. As a result, land has high pressure while the sea has comparatively a low pressure area. Gentle wind begins to blow from land (high pressure) towards sea (low pressure). This is known as land breeze (see fig. 11.9)

(ii) The Mountain and Valley Breezes

Another combination of local winds that undergoes a daily reversal consists of the mountain and valley breezes. On a warm sunny day the mountain slopes are heated more than the valley floor.

Hence, the pressure is low over the slopes while it is comparatively high in the valleys below. As a result gentle wind begins to blow from valley towards slopes and it assumes the name of valley breeze (see fig. 11.10).

After sunset, the rapid radiation takes place on the mountain slopes. Here, high pressure develops more rapidly than on the valley floor. Cold arid heavy air of mountain slopes starts moving down towards the valley floor. This is known as the mountain breeze (see fig. 11.10).

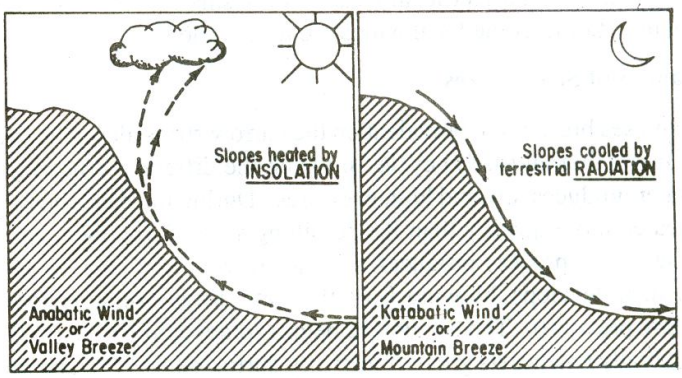
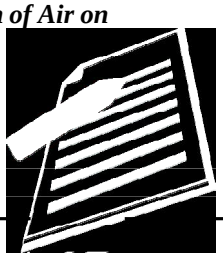


Fig. 11.10 : Mountain and Valley Breezes



The valley and mountain breezes are also named as anabatic and katabatic breezes respectively.

(iii) Hot Winds

Loo, Foehn and Chinook are important hot winds of local category.

(1) Loo

Loo are hot and dry winds, which blow very strongly over the northern plains of India and Pakistan in the months of May and June. Their direction is from west to east and they are usually experienced in the afternoons. Their temperature varies between 45°C to 50°C.

(2) Foehn

Foehn is strong, dusty, dry and warm local wind which develops on the leeward side of the Alps mountain ranges. Regional pressure gradient forces the air to ascend and cross the barrier. Ascending air sometimes causes precipitation on the windward side of the mountains. After crossing the mountain crest, the Foehn winds starts descending on the leeward side or northern slopes of the mountain as warm and dry wind. The temperature of the winds vary from 15°C to 20°C which help in melting snow. Thus making pasture land ready for animal grazing and help the grapes to ripe early.

(3) Chinook

Chinook is the name of hot and dry local wind which moves down the eastern slopes of the Rockies in U.S.A. and Canada. The literal meaning of chinook is 'snow eater' as they help in melting the snow earlier. They keep the grasslands clear of snow. Hence they are very helpful to ranchers.

(iv) Cold Winds

The local cold winds originate in the snow-capped mountains during winter and move down the slopes towards the valleys. They are known by different names in different areas.

(1) Mistral

Mistrals are most common local cold winds. They originate on the Alps and move over France towards the Mediterranean Sea through the Rhone valley. They are very cold, dry and high velocity winds. They bring down temperature below freezing point in areas of their influence. People in these areas protect their orchards and gardens by growing thick hedges and build their houses facing the Mediterranean sea.

INTEXT QUESTIONS 11.4

1. Choose the correct alternative for each of the following:

   (a) Foehn winds are

   (i) wet and dry (ii) cold, (iii) both wet and cold, (iv) none of them.

   (b) Chinooks are similar to

   (i) Foehn, (ii) Mistral, (iii) both of them, (iv) none of them.

2. Where from the Foehn wind originates.

   _____

3. Name the local wind which originate on the snow capped rockies and move down the eastern slopes.

4. Write hot or cold against each of the following

   (a) Loo _____

   (b) Mistral _____

   (c) Chinok _____

11.7 TROPICAL AND TEMPERATE CYCLONES

(1) Air Mass

An air mass is an extensive portion of the atmosphere having uniform characteristics of temperature, pressure and moisture which are relatively homogeneous horizontally.

An air mass develops when the air over a vast and relatively uniform land or ocean surface remains stationary for long time to acquire the temperature or moisture from the surface. The major source regions of the air masses are the high latitude polar or low latitude tropical regions having such homogeneous conditions. Air masses, therefore, are of two kinds-polar and tropical air masses. Polar air mass is cold and tropical air mass is warm. When cold air mass and warm air mass blow against each other, the boundary line of convergence separating the two air masses is termed as front. When the warm air mass, moves upward over the cold air mass the front formed in such a situation is called warm front. On the contrary, when the cold air mass advances faster and undercuts the warm air mass and forces the warm air upwards, the front so formed is called cold front. The frontal surface of cold front is steeper than that of a warm front (see fig 12.5). A prevailing air mass in any region - polar, tropical, maritime or continental largely controls the regions general weather.

(2) Cyclones

Typical cyclones are elliptical arrangement of isobars having low pressure at the centre with a convergence of winds within them. The wind direction in the cyclones is anti clockwise in the northern hemisphere and clockwise in the southern hemisphere. Cyclones are of two types - the temperate or mid latitude cyclones and the tropical or low latitude cyclones (see fig. 11.11)

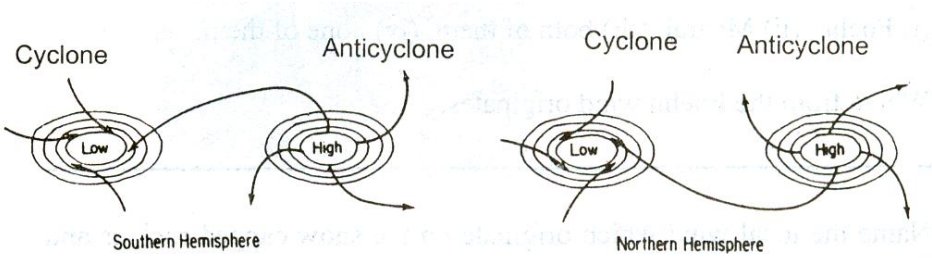


Fig. 11.11 : Movement of Wind associated with Cyclones and Anticyclone in Northern and Southern Hemisphere

(a) Temperate Cyclones

Temperate cyclones are formed along a front in mid-latitudes between 35° and 65° N and S. They blow from west to east and are more pronounced in winter season.

Atlantic Ocean and North West Europe are major regions of temperate cyclones. They are generally extensive having a thickness of 9 to11 kilometers and with 1040-1920 km short and long diametres respectively. Each such cyclone alternates with a high pressure anticyclone. The weather associated with the cyclone is drizzling rain and of cloudy nature for number of days. The anticyclone weather is sunny, calm and of cold waves.

(b) Tropical Cyclones

Tropical cyclones are formed along the zone of confluence of north-east and south-east trade winds. This zone is known as the Inter Tropical Convergence Zone (ITCZ). Cyclones generally occur in Mexico, South-Western and North Pacific Ocean, North Indian Ocean and South Pacific Ocean. These cyclones differ from temperate cyclones in many ways. There are no clear warm and cold fronts as temperature seldom differs in Inter Tropical Convergence Zone. They do not have well-defined pattern of winds and are energised by convectional currents within them. Generally, these are shallow depressions and the velocity of winds is weak. These are not accompanied by anticyclones. The arrangement of isobars is almost circular. These are not extensive and have the diametres of 160-640km. However, a few of them become very violent and cause destruction in the regions of their influence. They are called hurricanes in the Carribean Sea, typhoons in the China, Japan and phillipines,

cyclones in the Indian Ocean and willy-willies in Northern Australia (see fig. 11.12)

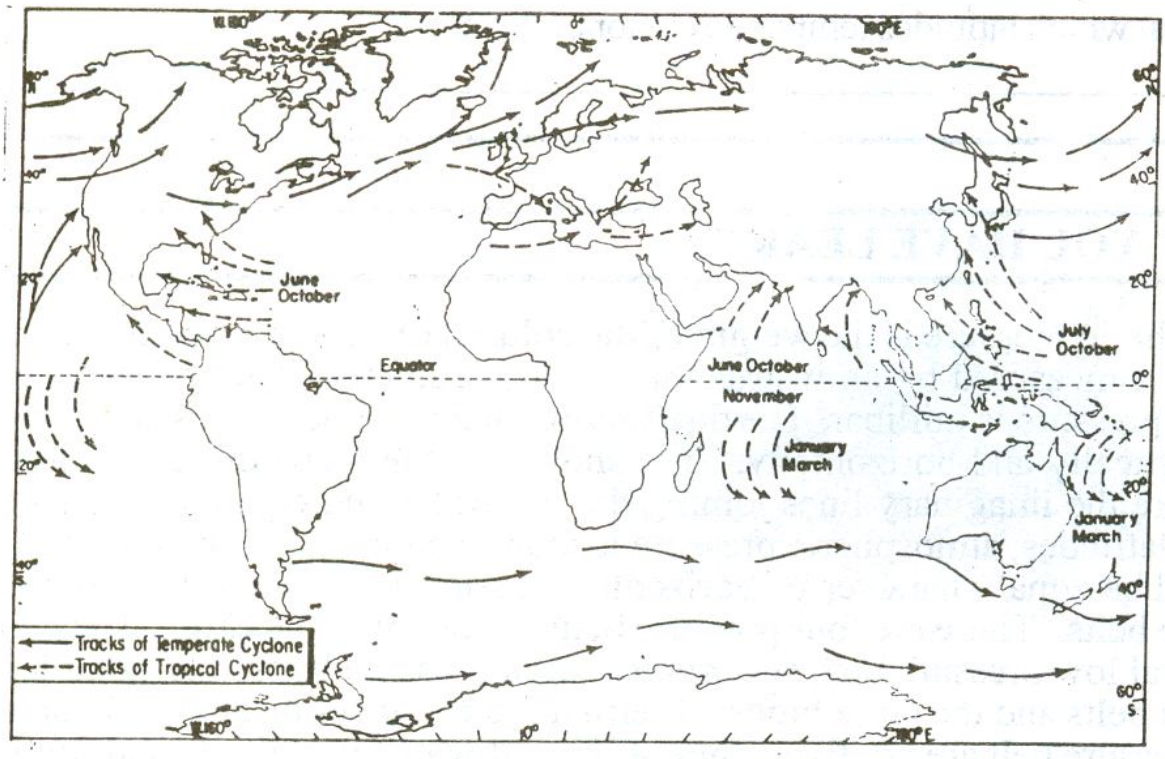


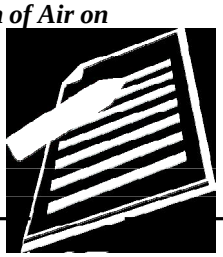
Fig. 11.12 : Tracks of Temperate and Tropical Cyclones

Tropical cyclones often cause destruction on the coasts. You would have heard cyclones striking Indian coasts in summer and autumn months. They cause heavy loss of life and property in these regions. The steeper pressure gradient causing strong high velocity winds and torrential rainfall bursting upon a restricted area combine to create distructive storms. However about 8 to 48 km. area around their centre called the eye of these stormy cyclones remains calm and rainless. If this eye is detected, it is possible for the modern science to stop further development of these strong cyclones and thus protecting us from them.

- An air mass is a large body of air having uniform temperature and moisture contents.
- The boundary line separating two air masses is termed as front.
- Temperate cyclones are prevalent in mid-latitudes while tropical cyclones develop in tropical regions.

INTEXT QUESTIONS 11.5

1. What is air mass?



2. Which type of cyclones cause heavy loss to life and property?

_____

3. In which latitudes temperate cyclones develop?

_____

WHAT YOU HAVE LEARNT

Atmospheric pressure is the weight of the column of air at a given place and time. It is measured by an instrument called barometer. Unit of measurement of pressure is millibar. The distribution of atmospheric pressure varies both vertically and horizontally. It is shown on the maps through isobars which are the imaginary lines joining the places having equal air pressure. In high latitudes, atmospheric pressure is more than the pressure at low latitudes. The zonal character of horizontal pressure is commonly known as pressure belts. There are four pressure belts spread over the earth. They are equatorial low pressure belt, sub-tropical high pressure belts, sub-polar low pressure belts and the polar highs. Thermal factor causes difference in pressure. Pressure belts are not fixed, they shift northwards in summer and south wards in winter with the apparent movement of the sun. Pressure gradient is the difference in horizontal pressure between regions of high pressure and region of low pressure. The difference in air pressure causes movement of air called wind. There are wind systems that blow regularly on a daily pattern. Examples include the land and sea breezes, the mountain and valley breezes and winds warmed as a result of compression. There is a close relationship between pressure gradient and wind speed. Due to Coriolis force, winds deflect from their original course. In Northern Hemisphere they deflect towards their right and in Southern Hemisphere towards their left. This is known as the Ferrel's law. Winds are grouped under planetary, Periodic and local winds. Planetary winds blow in the same direction throughout the year, while the other types of winds get modified due to certain reasons. Monsoon are seasonal winds while local winds below generally on diurnal basis. Air masses are horizontal large bodies of air which have uniform temperatures and moisture contents. The boundary line between two different air masses is called a front. Air masses and front cause temperate cyclones in mid-latitudes. Another type of cyclones are tropical cyclones which originate on tropical oceans and influence the coastal areas. Sometimes they turn violent and cause heavy loss to life and property.

TERMINAL QUESTIONS

1. Answer the following questions in about 30 words each.

(a) What is an atmospheric pressure?

(b) How is atmospheric pressure measured?

(c) What are the following?

(i) Millibars

(ii) Isobars.

(d) What is the effect of altitude on air pressure?

2. Distinguish between the following in 50 words each:

(a) Air current and wind.

(b) Planetary winds and periodic winds.

(c) Foehn and Mistral.

(d) Katabatic and Anabatic Breezes.

3. Give reasons for the following in 100 words:

(a) Low pressure is prevalent in sub-polar regions

(b) Sea breezes blow during day time.

(c) Winds change their direction in both the hemisphere.

4. Define the following:

(a) Air mass (b) front

5. What are temperate cyclones? How do they differ from tropical cyclones?

6. What is the role of coriolis force in the deflection of winds?

7. Explain the following terms:

(a) Horse latitudes (b) Doldrums

8. On an outline map of the world mark and label the following.

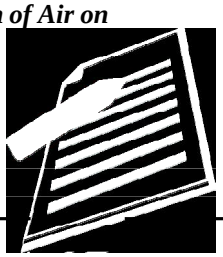
(a) Prominent areas of low pressure in January.

(b) Prominent areas of high pressure in July in Northern Hemisphere

ANSWER TO INTEXT QUESTIONS

11.1

1. (a) Air temperature (b) The earth's rotation (c) Presence of water vapour
2. (a) Fortin's barometer (b) Aneriod barometer
3. 1013.25 Millibar
4. (a) 76 cm (b) low pressure (c) Higher pressure



11.2

1. (a) thermal equator (b) altitude

   (c) the air pressure (d) pressure/density

2. (a) (i), (b) (ii), (c) (ii), (d) (iv).

11.3

1. (a) Trade winds (b) Westerlies

   (c) Polar easterlies

2. Winds or moving bodies turn towards their right in the northern hemisphere and towards their left in the Southern hemisphere. It is known as Ferrule's law.

3. (a) (i), (b) (i), (c) (ii), (d) (iii)

11.4

1. (a) (iv) (b) (i)

2. On the leeward side of the Alps Mountains.

3. Chinook

4. (a) Hot, (b) cold, (c) Hot

11.5

1. A large body of air which has uniform temperature and moisture contents is called air mass.

2. Tropical and polar

3. Mid latitudes

HINTS TO TERMINAL QUESTIONS

1. (a) The weight of the air column at a place at a given time.

   (b) Air pressure is measured by an instrument called barometer.

   (i) The unit used for measuring air pressure. It is approximately equal to the force of one gram per square centimeter.

   (ii) Isobars are lines connecting points that have equal values Pressure.

   (d) Pressure decreases with increase in attitude.

2. (a) please refer to para 11.5

   (b) please refer to para 11.6 (a) and (b)

(c) please refer to para 11.6 (c) (iii) (2) and (iv) (1)

(d) please refer to para 11.6 (c) (ii)

3. (a) please refer to para 11.3 (iii)

(b) please refer to para 11.6 (c) (i)

(c) please refer to para 11.5 (ii)

4. (a) Air mass: a large body of air having uniformity of temperature, pressure and moisture.

(b) Front: the boundary line of convergence separating two different air masses.

5. Please refer to para 11.7 (2) (a) and (b)

6. Please refer to para 11.5 (ii)

7. (a) Horse latitudes is the region of sub-tropical high pressure belts of Northern hemisphere.

(b) Doldrums are the regions of calm in equatorial areas where winds are negligible and ascending air current are prominent.

8. Please see maps 11.3 and 11.4