10. Atmospheric Circulation and Weather Systems

1. Multiple choice question

(i) If the surface air pressure is 1,000 mb, the air pressure at 1 km above the surface will be:

(a) 700 mb
(b) 1,100 mb
(c) 900 mb
(d) 1,300 mb

Answer: (c) 900 mb

(ii) The Inter Tropical Convergence Zone normally occurs:

(a) near the Equator
(b) near the Tropic of Cancer
(c) near the Tropic of Capricorn
(d) near the Arctic Circle

Answer: (a) near the Equator

(iii) The direction of wind around a low pressure in northern hemisphere is:

(a) clockwise

(b) perpendicular to isobars

(c) anti-clock wise

(d) parallel to isobars

Answer: (c) anti-clock wise

(iv) Which one of the following is the source region for the formation of air masses?

(a) the Equatorial forest

(b) the Himalayas

(c) the Siberian Plain

(d) the Deccan Plateau

Answer: (c) the Siberian Plain

2. Answer the following questions in about 30 words.

(i) What is the unit used in measuring pressure? Why is the pressure measured at station level reduced to the sea level in preparation of weather maps?

Answer: The atmospheric pressure is expressed in units of milibar (mb). At sea level, the average atmospheric pressure is 1,013.2 milibar. Due to gravity, the air at the surface is denser and hence has higher pressure. Pressure measure at a station is reduced to sea level to offset the effect of altitude.

(ii) While the pressure gradient force is from north to south, i.e. from the subtropical high pressure to the equator in the northern hemisphere, why are the winds north easterlies in the tropics.

Answer: The rotation of the earth on its axis affects the direction of the wind. Under the influence of Coriolis force, winds get deflected to their right in northern hemisphere and to their left in the southern hemisphere. The Coriolis force is an inertial force that acts on objects that are in motion relative to a rotating reference frame. French physicist described it in 1844. Therefore, winds are north-easterlies in the tropics of the northern hemispher

(iii) What are the geotrophic winds?

Answer: The geostrophic wind is the theoretical wind that would result from an exact balance between the Coriolis Effect and the Pressure Gradient Force.

(iv) Explain the land and sea breezes.

Answer: During the day, the land heats up faster and becomes warmer than the sea. Thus, pressure gradient from sea to land is created and the wind blows from the sea to the land as the sea breeze. In the night, the reversal of condition takes place. The land loses heat faster and is cooler than the sea. The pressure gradient is from the land to the sea and hence land breeze results.

3. Answer the following questions in about 150 words

(i) Discuss the factors affecting the speed and direction of wind.

Answer: The air in motion is called wind. The wind blows form high pressure to low pressure. However, direction and speed of wind are controlled by a combination of following factors:

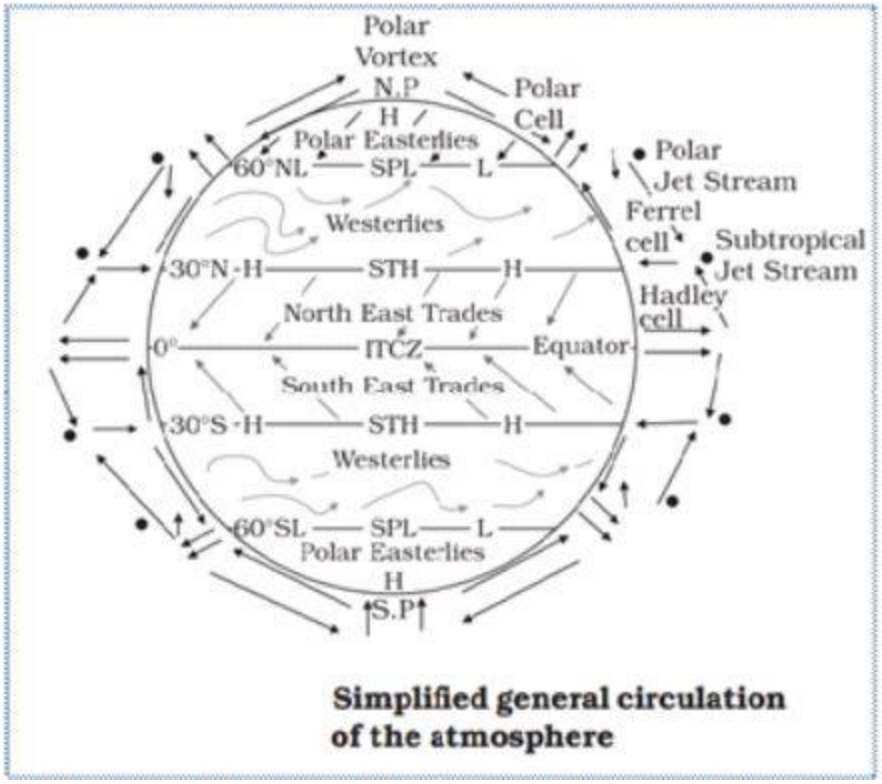
Pressure Gradient Force: Differences in horizontal distribution of atmospheric pressure drives the winds from areas of high pressure to areas of low pressure. The greater the pressure gradient and its force, higher will be the wind speed.

Coriolis Effect: The rotation of the earth on its axis affects the directions of the winds. Under the influence of Coriolis force, winds get deflected to their right in northern hemisphere and to their left in the southern hemisphere.

Frictional Forces: It affects the speed of wind. Over the sea surface, the friction is minimal. Land features like mountains, plateaus and valleys bring about a change in the speed and direction of the winds.

(ii) Draw a simplified diagram to show the general circulation of the atmosphere over the globe. What are the possible reasons for the formation of subtropical high-pressure over 30° N and S latitudes?

Answer:



Simplified general circulation of the atmosphere

Reasons for formation of subtropical high pressure over 30°N and S latitudes: The warm air of the equatorial belt gradually cools down, when it goes up and turns towards the north and

south in the northern and southern hemisphere respectively due to rotation of the earth. It reaches the top of the troposphere up to an altitude of 14 km and moves towards the poles. This causes accumulation of air at about 30° north and south part of this air sinks at ground and form subtropical high. Thus, descend of cold air causes high-pressure. Large air masses drift from the polar areas to the sub-tropics due to earth's rotation and causes high pressure there.

(iii) Why does tropical cyclone originate over the seas? In which part of the tropical cyclone do torrential rains and high velocity winds blow and why?

Answer: Tropical cyclones are violent storms that originate over oceans in tropical areas and move over to the coastal areas bringing about large-scale destruction caused by violent winds, very heavy rainfall, and storm surges.

Origin of Tropical Cyclones: The tropical cyclones originate and intensify over warm tropical oceans. Following conditions are most suitable for the birth and growth of tropical cyclones:

Large sea surface with temperature more than 27°C

Presence of the Coriolis force

Small variations in the vertical wind speed

A pre-existing weak-low-pressure area or low-level- cyclonic circulation

Upper divergence above the sea level system

Around the eye is the eye wall, where there is a strong spiralling ascent of air to greater height reaching the tropopause. The wind reaches maximum velocity in this region, reaching as high as 250 km per hour. Torrential rain occurs here. From the eye wall, rain bands may radiate and trains of cumulus and cumulonimbus clouds may drift into the outer region. The cyclone creates storm surges and they inundate the coastal low lands. The storm peters out of the land.