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B.A. PART - 1 (PHYSICAL GEOGRAPHY : PAPER - 1)

TOPIC : FRONTS

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When unlike air masses meet, they do not mix readily; instead, a boundary zone called a front develops between them. A front is not a simple two-dimensional boundary. A typical front is a narrow three-dimensional transition zone several kilometers or even tens of kilometers wide. Within this zone, the properties of the air change rapidly.

The frontal concept was developed by Norwegian meteorologists during World War I, and the term front was coined because these scientists considered the clash between unlike air masses to be analogous to a confrontation between opposing armies along a battle front. As the more "aggressive" air mass advances at the expense of the other, some mixing of the two occurs within the frontal zone, but for the most part the air masses retain their separate identities as one is displaced by the other.

TYPES OF FRONTS

(Cold, Warm, Stationary, and Occluded)

- The most conspicuous difference between air masses is usually temperature. A cold front forms where an advancing cold air mass meets and displaces warmer air (see image), whereas a warm front forms where an advancing warm air mass meets colder air (see image).

- In both cases, there is warm air on one side of the front and cool air on the other, with a fairly abrupt temperature gradient between.
- Air masses may also have different densities, humidity levels, wind patterns, and stability, and so these factors can have a steep gradient through the front as well. In some cases, a front may remain stationary for a few hours or even a few days.
- More commonly, however, a front is in more or less constant motion. Usually one air mass is displacing the other; thus, the front advances in the direction dictated by the movement of the more active air mass. Regardless of which air mass is advancing, it is always the warmer air that rises over the cooler.
- The warmer, lighter air is inevitably forced aloft, and the cooler, denser air mass functions as a wedge over which the lifting occurs. As you can see in both the images fronts "lean" or slope upward from the surface, and it is along this slope that the warmer air rises and cools adiabatically to form clouds and often precipitation.
- Indeed, fronts lean so much that they are much closer to horizontal features than vertical ones. The slope of a typical front averages about 1:150, meaning that 150 kilometers away from the surface position of the front, the height of the front is only 1 kilometer above the ground.
- Because of this very low angle of slope (less than 1°), the steepness shown in most diagrams of fronts is greatly exaggerated. Notice that the "leading edge" of a cold front precedes its higher altitude "trailing edge," whereas a warm front leans "forward" so that the higher altitude part of the front is ahead of its lower altitude "trailing edge."

1.COLD FRONTS

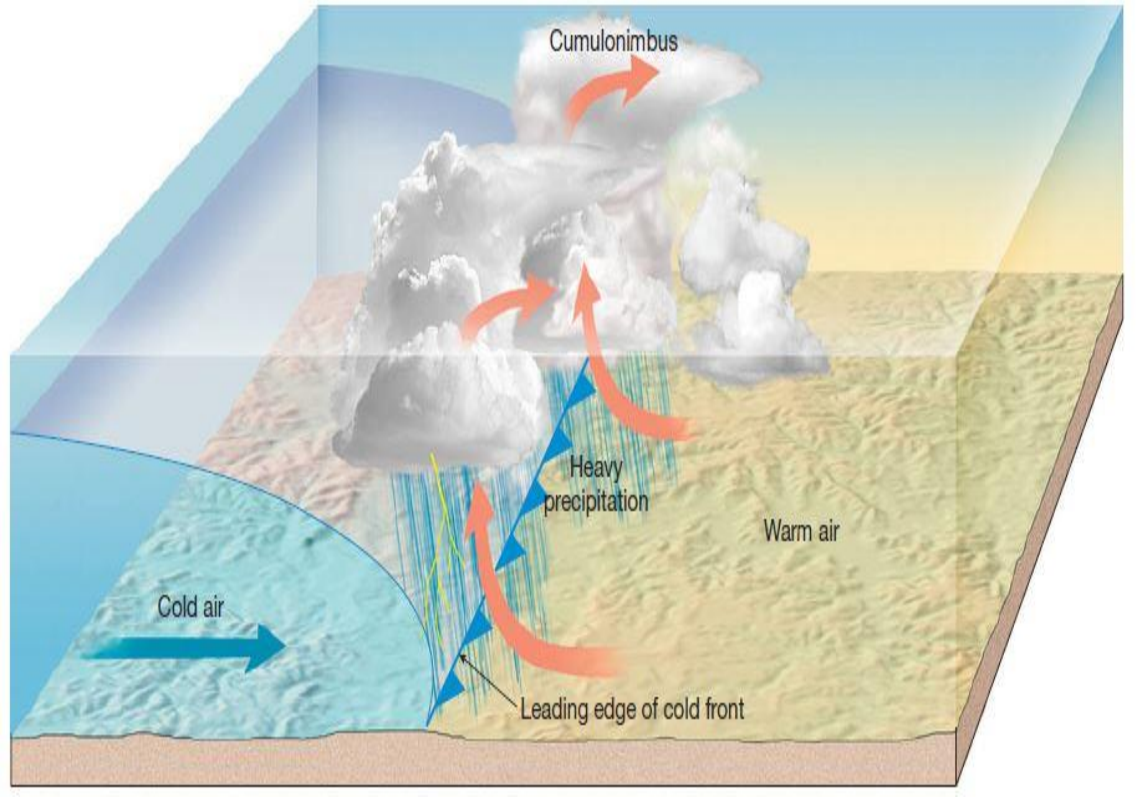

Image Explanation: A cold front forms when a cold air mass is actively underriding a warm air mass. As a cold front advances, the warm air ahead of it is forced upward. This displacement often creates cloudiness and relatively heavy precipitation along and immediately behind the groundlevel position of the front. (In this diagram, the vertical scale has been exaggerated.)

Because of friction with the ground, the advance of the lower portion of a cold air mass is slowed relative to the upper portion. As a result, a cold front tends to become steeper as it moves forward and usually develops a protruding "nose" a few hundred meters above the ground.

- The average cold front is twice as steep as the average warm front. Moreover, cold fronts normally move faster than warm fronts because the dense, cold air mass easily displaces the lighter, warm air.

This combination of steeper slope and faster advance leads to rapid lifting and adiabatic cooling of the warm air ahead of the cold front. The rapid lifting often makes the warm air very unstable, and the result is blustery and violent weather along the cold front.

- Vertically developed clouds, such as cumulonimbus clouds, are common, with considerable turbulence and showery precipitation.
- Both clouds and precipitation tend to be concentrated along and immediately behind the ground-level position of the front. Precipitation is usually of higher intensity but shorter duration than that associated with a warm front.
- On a weather map, the ground-level position of a cold front is shown either by a blue line or a solid line studded at intervals with solid triangles that extend in the direction toward which the front is moving.

2.WARM FRONTS

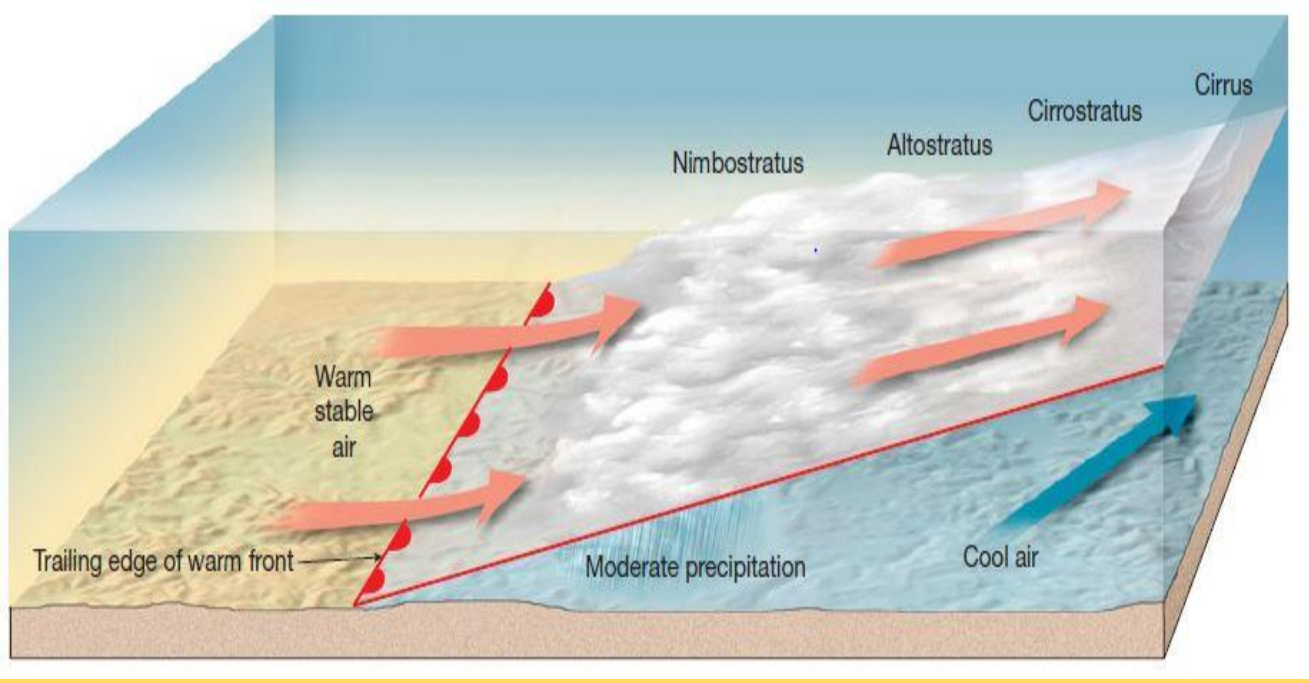

Image Explanation – A warm front forms when a warm air mass is actively overriding a cold air mass. As warm air rises above cooler air, widespread cloudiness and precipitation develop along and in advance of the ground-level position of the front. Higher and less dense clouds are often dozens or hundreds of kilometers ahead of the ground-level position of the front. (In this diagram, the vertical scale has been exaggerated.)

The slope of a typical warm front is more gentle than that of a cold front, averaging about 1:200. As the warm air pushes against and rises over the retreating cold air, it cools adiabatically, usually resulting in clouds and precipitation.

Because the frontal uplift is very gradual, clouds form slowly and turbulence is limited. High-flying cirrus clouds may signal the approaching front many hours before it arrives. As the front comes closer, the clouds become lower, thicker, and more extensive, typically developing into altocumulus or altostratus. Precipitation usually occurs broadly;

- It is likely to be protracted and gentle, without much convective activity. If the rising air is inherently unstable, however, precipitation can be showery and even violent. Most precipitation falls ahead of the ground-level position of the moving front.
- The ground-level position of a warm front is portrayed on a weather map either by a red line or by a solid line along which solid semicircles are located at regular intervals, with the semicircles extending in the direction toward which the front is moving

3.STATIONARY FRONTS

When neither air mass displaces the other or if a cold front or warm front "stalls" their common boundary is called a stationary front. It is difficult to generalize about the weather along such a front, but often gently rising warm air produces limited precipitation similar to that along a warm front.

- As Image shows, stationary fronts are portrayed on a weather map by a combination of warm and cold front symbols, alternating on opposite sides of the line—cold air is opposite the triangles, and warm air opposite the half circles.

4.OCCLUDED FRONTS

A fourth type of front, called an occluded front, is formed when a cold front overtakes a warm front. Occluded fronts are shown on a weather map by a combination of warm and cold front symbols, alternating on the same side of the line.

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