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Humidity, Clouds and Precipitation

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Humidity, Clouds and Precipitation

Water vapour makes up only a tiny slice of the air. Yet it drives every cloud, every raindrop and every hailstone that ever falls.



A cumulonimbus cloud, the towering, rain-and-hail-producing cloud built from repeated cumulus growth. Photo: NOAA Photo Library, public domain, via Wikimedia Commons.

Four cloud families, one sky

Learn the height order as one ladder: low, middle, then high

01
Cirrus

Highest and feathery. Its height band shifts with latitude: about 3 to 8 km over polar regions, 5 to 13 km in temperate regions, 6 to 18 km in the tropics.

02
Cumulus

Cotton-wool clouds, usually low-based, with bases commonly below about 2,000 metres. Developing cumulus can grow much taller.

03
Stratus

> Layered and wide, covering large areas of the sky.
>
> 04
> Nimbus
>
> Dark and rain-bearing, sitting at low or middle level.

Dew point The exact temperature at which air becomes saturated with water vapour.
SleetFrozen raindrops, formed when warm air overlies a colder layer near the ground.
Orographic rain Rain forced out of moist air as it rises over a mountain slope.
Convectional rain Rain from heated air rising and condensing into cumulus clouds.

Humidity, Clouds and the Air

Must Know

Humidity and Saturation

- Absolute humidity is the actual weight of water vapour in a given volume of air, measured in grams per cubic metre.
- Relative humidity compares how much moisture air holds against its full capacity at that temperature. It is higher over oceans and lower over continents.
- Air is saturated once it holds all the moisture it can at a given temperature. The exact temperature where this happens is the **dew point**.
- Evaporation turns liquid water into vapour, adding moisture to the air. Condensation is the reverse, turning vapour back into water and

releasing that moisture. In free air, condensation needs tiny hygroscopic nuclei, dust, smoke or ocean salt, for water vapour to gather around.

> **Quick check 1.** Q1. True or False: The dew point is the exact temperature at which a sample of air becomes saturated with water vapour. *(True or False?)* See answer ↓

Dew, Frost, Fog and the Four Cloud Types

- Dew forms when moisture condenses onto cool surfaces like grass, but only when the dew point stays above freezing. Frost forms the same way, except the dew point sits at or below freezing, so ice crystals form instead of liquid droplets.
- Fog is condensation near the ground that cuts visibility sharply. Mist is a thinner suspension of droplets than fog, with better visibility. Fog means visibility below 1 km, and mist means 1 km or more. Smog is fog mixed with urban smoke.
- **Cirrus** clouds are thin, feathery, and highest up. They sit about 5 to 13 km high in temperate regions, lower near the poles and higher in the tropics, where they can reach 18 km. Cumulus clouds look like cotton wool. Stratus clouds are flat layers covering wide areas. Nimbus clouds are dark and rain-bearing.
- These four basic types combine into named varieties, like cirrocumulus, altostratus, stratocumulus, and the towering, thunder-and-hail-producing cumulonimbus. Exams test the height order of cloud types directly. Learn it as one ladder: nimbostratus and stratocumulus at low level, altostratus at middle level, then cirrus and cirrocumulus at high level.

Quick check 2. Q2. True or False: Cirrus clouds form highest in the sky and have a thin, feathery appearance made of ice crystals. *(True or False?)* See answer ↓

Think it through, before reading on. Dew forms on cool grass on many ordinary nights, with no drama at all. Frost looks similar, but needs a specific extra condition to form instead of dew. What is that one extra condition?

Show the explanation

The condition is simply where the dew point itself happens to sit relative to freezing, nothing more exotic than that. Dew and frost form through the exact same basic process: air cools near a surface until it reaches its dew point, and moisture condenses out of it. When that dew point sits above freezing, the moisture condenses as ordinary liquid water droplets, and that is dew. When the dew point itself sits at or below freezing, the water vapour skips the liquid stage entirely and deposits straight onto the surface as ice crystals, and that is frost. So the difference between a damp lawn and a frosty one on a cold morning comes down to a single number, whether the dew point that night was above or below zero degrees, not to any separate weather mechanism.

Precipitation and Rainfall Patterns

Good to Know

Precipitation: Rain, Snow, Sleet and Hail

- Precipitation falls as rain above freezing, or as snowflakes, delicate hexagonal ice crystals, once temperature drops below 0°C.

- **Sleet** is frozen raindrops or refrozen melted snow. It forms when a warmer air layer above overlies a colder, subfreezing layer near the ground.
- **Hail** forms inside thunderstorms. Strong updrafts carry raindrops up into very cold air. A small ice particle then grows as **supercooled water droplets** freeze onto it. Each stone's path through the storm is different, so size and layering vary. Many hailstones show layers of clear and cloudy ice when cut open. But not every stone needs many trips up and down, or neat rings.

> **Quick check 3.** Q3. True or False: Sleet forms when a layer of air above freezing overlies a colder, subfreezing layer near the ground. *(True or False?)* See answer ↓

Three Types of Rainfall, Around the World

- **Convectional rain** comes from heated air rising, cooling, and condensing into cumulus clouds, often with thunder and lightning. It is common in the equatorial belt and on hot summer afternoons, feeding directly into the daily weather pattern covered in our Monsoon Climate article.
- **Orographic rain** forms when moist air is forced upward by a mountain, cools, and drops its rain on the windward slope. The leeward slope stays dry, in what is called a rain-shadow area.
- Cyclonic rain comes from rising air along weather fronts, tied to extra-tropical cyclones, the same storm systems explored further in our Cyclones article.
- Rainfall generally decreases steadily from the equator toward the poles, and coasts get more rain than continental interiors. The equatorial belt, windward mountain slopes in the cool temperate

zone, and monsoon coasts, like those shaped by the Indian Monsoon, all receive over 200 cm a year.

- Continental interiors sitting in a rain shadow, along with high-latitude regions, receive under 50 cm a year, the lowest rainfall band on Earth. Interior Maharashtra, sitting behind the Western Ghats, is a well-known real example of a rain-shadow area.

> **Quick check 4.** Q4. True or False: Orographic rain falls when moist air is forced up a mountain slope, leaving the far side dry as a rain-shadow area. *(True or False?)* See answer ↓

> **Quick check 5.** Q5. True or False: Cyclonic rain is caused by heated air rising and forming cumulus clouds, common in the equatorial belt. *(True or False?)* See answer ↓

Remember the pattern. Exam questions almost always swap two paired facts, which cloud is high versus low, which air layer is warm versus cold. Learn each pair together, not as two separate facts.

Quick Q&A

What is the dew point?

The exact temperature at which a sample of air becomes saturated with water vapour.

Which cloud type forms highest in the sky?

Cirrus, thin and feathery. Roughly 5 to 13 km in temperate regions, 3 to 8 km near the poles, 6 to 18 km in the tropics.

What causes a rain-shadow area?

Orographic rain falling on a mountain’s windward slope, leaving the leeward side dry.

When does sleet form?

When a layer of air above freezing overlies a colder layer near the ground.

📝 Exam Point of View

🔗 Related Topics

- **Climatology: Atmosphere, Weather and Climate**
- **The Indian Monsoon: Mechanism and Drivers**
- **The Monsoon Climate: Daily Weather Pattern**
- **Earth’s Heat Budget and Temperature Distribution**

✅ MCQ on Humidity, Clouds and Precipitation

🎲 More World Geography Practice

Practice MCQs

1. The temperature at which a given sample of air becomes saturated with water vapour is called the:

A. Relative humidity

B. Dew point

C. Latent heat

D. Absolute humidity

See answer ↓

2. Which cloud type forms highest in the sky and has a thin, feathery appearance?

A. Stratus

B. Cumulus

C. Cirrus

D. Nimbus

See answer ↓

3. Rain that falls when moist air is forced up a mountain slope, leaving the far side dry as a rain-shadow area, is called:

A. Orographic rain

B. Cyclonic rain

C. Convectional rain

D. Frontal rain

See answer ↓

4. Sleet forms when:

A. A layer of air above freezing overlies a colder, subfreezing layer near the ground

B. Rain falls directly through freezing fog

C. A layer of subfreezing air overlies a warmer layer near the ground

D. Hailstones melt on the way down

See answer ↓

5. Rain caused by heated air rising, cooling, and forming cumulus clouds, often with thunder and lightning, and common in the equatorial belt, is called:

A. Cyclonic rain

B. Orographic rain

C. Frontal rain

D. Convectional rain

See answer ↓

Answer Key

1. **B.** The dew point is the exact temperature at which air becomes fully saturated and can hold no more water vapour. ↑ Q1
2. **C.** Cirrus clouds form at the highest altitudes of the main cloud types and are thin, detached and feathery, made of ice crystals. Their height depends on latitude: about 3 to 8 km near the poles, 5 to 13 km in temperate regions and 6 to 18 km in the tropics (WMO). ↑ Q2
3. **A.** Orographic rain falls on the windward slope of a mountain as moist air is forced upward and cools. The leeward slope stays dry as a rain-shadow area. ↑ Q3
4. **A.** Sleet forms when a layer of air above freezing point overlies a colder, subfreezing layer near the ground, refreezing the raindrops into ice pellets. ↑ Q4
5. **D.** Convectional rain results from heated air rising in convection currents, condensing into cumulus clouds, and often bringing thunder and lightning; it is common in equatorial regions. ↑ Q5

Quick-check answers

1. **True.** ↑ 1
2. **True.** ↑ 2
3. **True.** ↑ 3
4. **True.** ↑ 4
5. **False.** ↑ 5

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