GC

GAS CHROMATOGRAPHY

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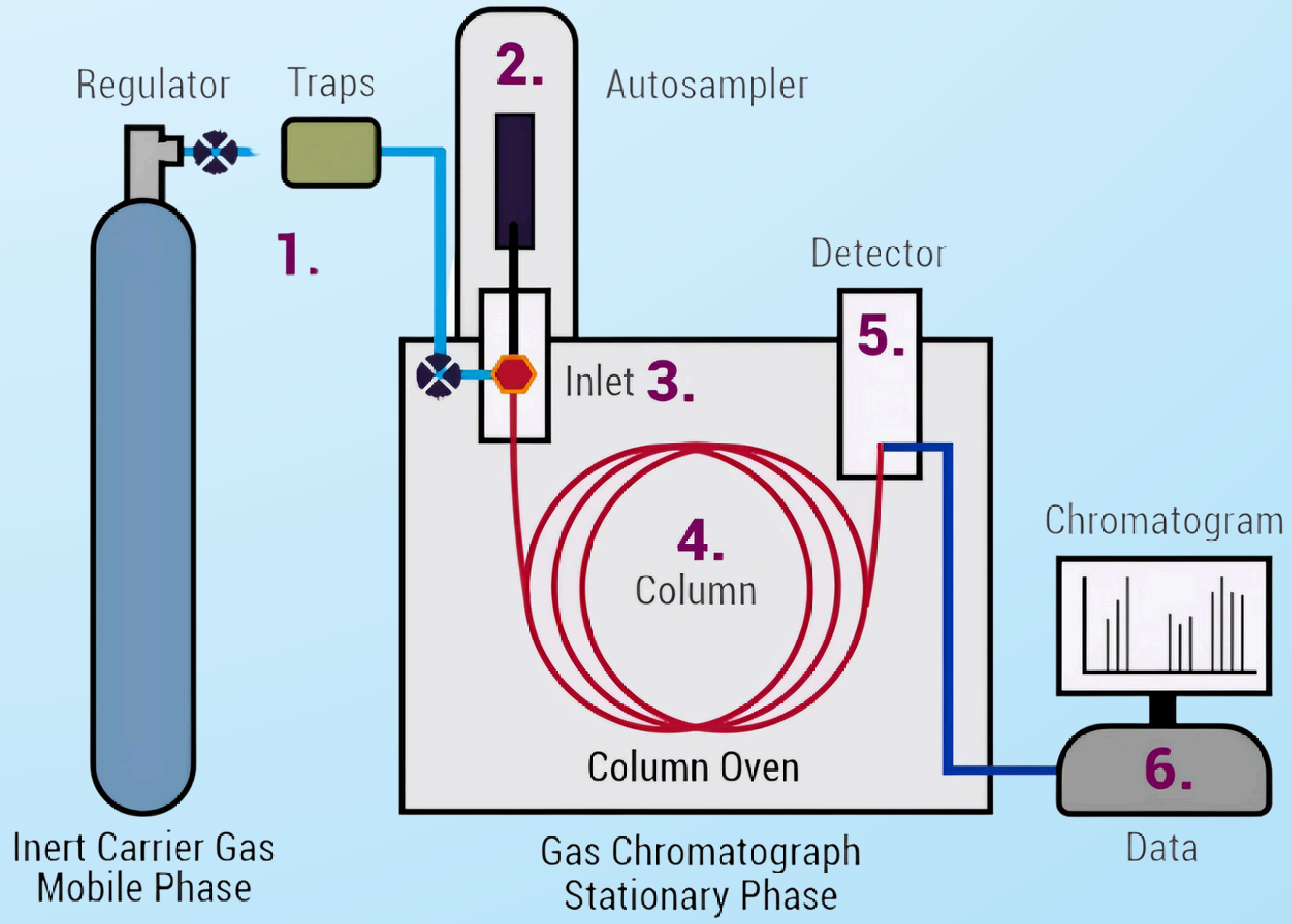
What is GC ?

Gas Chromatography (GC) is a common analytical technique used to separate and analyze compounds that can be vaporized without decomposition. It is widely used in various fields such as chemistry, biology, and environmental science.



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Principle of GC

Gas Chromatography separates the components of a mixture based on their different interactions with a stationary phase (inside the column) and a mobile phase (carrier gas). The sample is vaporized and carried by an inert gas (such as helium or nitrogen) through a column coated with the stationary phase. As the sample travels through the column, its components separate based on their volatilities and interactions with the stationary phase.

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Key Components of GC

1. CAREER GAS SUPPLY

Carrier Gas

An inert gas (e.g., helium, nitrogen, hydrogen) that acts as the mobile phase.

Flow Controller & Pressure Regulators

These ensure a constant flow of the carrier gas.

2. INJECTOR

The sample is introduced into the gas chromatograph through the injector, where it is vaporized if not already in the gaseous state. Common injection methods include split, splitless, and on-column injection.

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3. COLUMN

Carrier Gas

Two main types are packed columns (filled with solid particles coated with the stationary phase) and capillary (or open tubular) columns (a long, narrow tube coated with the stationary phase on the inner wall).

Stationary Phase

This is the material within the column that interacts with the sample components. It can be a liquid or solid phase that adsorbs or dissolves the compounds differently.

4. OVEN

The column is housed in a temperature-controlled oven. The temperature can be programmed to increase gradually (temperature programming) to help separate compounds with a wide range of boiling points.

5. DETECTOR

Detects the separated components as they exit the column. Common types of detectors include Flame Ionization Detectors (FID), Thermal Conductivity Detectors (TCD), Electron Capture Detectors (ECD), and Mass Spectrometers (MS).

6. DATA SYSTEM

Collects and analyzes the data from the detector. Produces a chromatogram, which is a graphical representation of detector response versus retention time.

Steps in GC

1. SAMPLE INJECTION

A small amount of liquid or gas sample is injected into the injector. The injector vaporizes the sample and mixes it with the carrier gas.

2. SEPERATION IN THE COLUMN

The sample vapor is carried by the carrier gas into the column. As the sample passes through the column, components separate based on their different affinities for the stationary phase and their different boiling points. Components with lower boiling points or less affinity for the stationary phase travel faster and elute earlier.

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3. DETECTION

Separated components exit the column and enter the detector. The detector generates a signal proportional to the amount of each component.

4. DATA ANALYSIS

The signals from the detector are recorded and plotted as a chromatogram. Peaks on the chromatogram represent different components, with their position (retention time) indicating the type of compound and the area under the peak proportional to the amount of the compound.

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Applications of GC

1. FOOD & BEVERAGE INDUSTRY

Determination of flavors, fragrances, and contaminants.

2. PHARMACEUTICAL INDUSTRY

Analysis of drug compounds and impurities.

3. ENVIRONMENTAL ANALYSIS

Detection of pollutants in air, water, and soil.

4. PETROCHEMICAL INDUSTRY

Analysis of hydrocarbons and other chemicals in petroleum products.

5. FORENSIC SCIENCE

Identification of substances in criminal investigations.

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Advantages of GC

High resolution and sensitivity.

Ability to analyze complex mixtures.

Quantitative and qualitative analysis capabilities.

Wide range of detectors available for different applications.

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Limitations of GC

Only volatile and thermally stable compounds can be analyzed.

Sample preparation may be required.

High operational costs due to the need for high-purity gases and maintenance of equipment.

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The Bottom Line

Gas Chromatography is a powerful tool in analytical chemistry, providing detailed information about the composition of complex mixtures. Its versatility and precision make it indispensable in many scientific and industrial applications.

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