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**Question 1**

Describe, in detail, compare and contrast gas chromatography and gas chromatography-mass spectrometry.

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| **Gas chromatography** | **Gas chromatography–mass spectrometry** |
| **Gas chromatography** (**GC**) is a common type of [chromatography](https://en.wikipedia.org/wiki/Chromatography) used in [analytical chemistry](https://en.wikipedia.org/wiki/Analytical_chemistry) for [separating](https://en.wikipedia.org/wiki/Separation_process) and analyzing compounds that can be [vaporized](https://en.wikipedia.org/wiki/Vaporized) without [decomposition](https://en.wikipedia.org/wiki/Chemical_decomposition). | **Gas chromatography–mass spectrometry** (**GC-MS**) is an [analytical](https://en.wikipedia.org/wiki/Analytical_chemistry) method that combines the features of [gas-chromatography](https://en.wikipedia.org/wiki/Gas-chromatography) and [mass spectrometry](https://en.wikipedia.org/wiki/Mass_spectrometry) to identify different substances within a test sample. |
| Application of GC include: testing the purity of a particular substance, or separating the different components of a mixture (the relative amounts of such components can also be determined), used to prepare pure compounds from a mixture, GC may help in identifying a compound | Applications of GC-MS include: [drug](https://en.wikipedia.org/wiki/Drug_abuse) detection, [fire](https://en.wikipedia.org/wiki/Fire) investigation, environmental analysis, [explosives](https://en.wikipedia.org/wiki/Explosives) investigation, and identification of unknown samples |
| GC presents an insufficient proof of the nature of the detected compounds. The identification is based on retention time matching that may be inaccurate or misleading | GC-MS has been regarded as a "gold standard" for forensic substance identification because it is used to perform a 100% specific test, which positively identifies the presence of a particular substance. Additionally, it can identify trace elements in materials that were previously thought to have disintegrated beyond identification. |
| Gas Chromatography is used to separate mixtures of chemicals into individual components. Once isolated, the components can be evaluated individually. | Gas chromatography–mass spectrometryseparates the components of a mixture as well as characterizes each of the components individually. By combining the two techniques, an analytical chemist can both qualitatively and quantitatively evaluate a solution containing a number of chemicals.  |
| GC can separate volatile components in a sample but requires the coupling a detector such as Flame Ionization (FID), Thermal Conductivity (TCD) Electron-Capture (ECD) etc. to identify the sample separated. i.e. detector is not inbuilt | Gas chromatography–mass spectrometry (GC-MS) is a hybrid analytical technique that couples the separation capabilities of GC with the detection properties of MS to provide a higher efficiency of sample analyses. While GC can separate volatile components in a sample, MS helps fragment the components and identify them on the basis of their mass. i.e. detector is inbuilt |
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