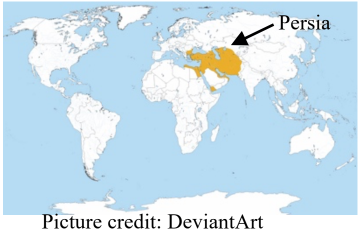
<u>Information Sheet for Teachers: Jabir Ibn Hayyan (721- 815 AD)</u>

This information sheet is designed for teachers only.

Jabir Ibn Hayyan made fantastic contributions to chemistry which are crucial in industry today. After looking at the KS5 national curriculum, it is evident that his contributions to chemistry can be highlighted. The curriculum states: '*The Bronsted–Lowry theory of acid–base reactions. The ionic product of water, Kw; pH and its calculation for strong acids and strong bases.'* Students should understand what is meant by the term strong acid as well as examples of them. Two examples of strong acids are hydrochloric acid and nitric acid. Jabir Ibn Hayyan discovered both these acids using distillation. The national curriculum also includes, '*Organic synthesis, including characteristic reactions of alkanes, alkenes, halogenoalkanes, alcohols, arenes, aldehydes, ketones, carboxylic acids, esters, amines, amino acids and amides.'* One of the key techniques in A Level Chemistry is distillation. This analytical technique was invented/discovered by Jabir Ibn Hayyan. The process of distillation can be used for organic synthesis. Additionally, the CPAC (Common Practical Assessment Criteria) in the national curriculum says, '*Distillation and heating under reflux, including setting up glassware using retort stand and clamps.'* Jabir's work shows a clear link to the national curriculum and his contributions could be incorporated without difficulty.

Jabir Ibn Hayyan

Jabir Ibn Hayyan, commonly known as the 'Father of Arab Chemistry', was born in Persia, which is now known as Iran, in 721 AD. His contributions to chemistry include the findings of several chemical compounds and techniques which are still widely used today (e.g., distillation). Jabir also looked at other topics which included medicine, pharmacology, zoology, and astronomy.



Picture credit: DeviantArt

Figure shows an alembic
Picture credit:
Merriam-Webster

Jabir Ibn Hayyan helped develop several laboratory processes which are routinely carried out in chemistry laboratories: crystallisation, distillation, filtration, and calcination. When he discovered the technique of distillation, he used an alembic, which originates from the word 'beaker', and is a type of still.

Picture credit: Great Personalities

Jabir Ibn Hayyan also discovered hydrochloric acid and nitric acid - both are known as strong acids. These were discovered by the distillation of several salts with sulfuric acid. He then went on to combine both hydrochloric and nitric acid to form nitrohydrochloric acid, which is more commonly known as *aqua regia*. *Aqua regia* contains a 3:1 ratio of hydrochloric to nitric acid and can dissolve gold, which is extremely useful for the extraction of gold. Since gold in an inert metal, it will dissolve in *aqua regia*. This method doesn't pollute the environment and can quickly extract the gold.

A further discovery of Jabir Ibn Hayyan included those certain substances can make water softer, which are called alkali. He also discovered how to prevent of rust from forming and improved the production of steel. Throughout chemistry, there are several occasions where the syllable 'Al' is used: alchemy, alkali, alcohol, algebra. The syllable 'Al-' originates from Arabic and means 'The'.

Jabir Ibn Hayyan's discoveries in chemistry had a huge impact on modern practical chemistry. Several analytical techniques he discovered are still used by scientists today including crystallisation, distillation, filtration, and calcination. An example of how distillation is used on a larger scale is fractional distillation of crude oil.

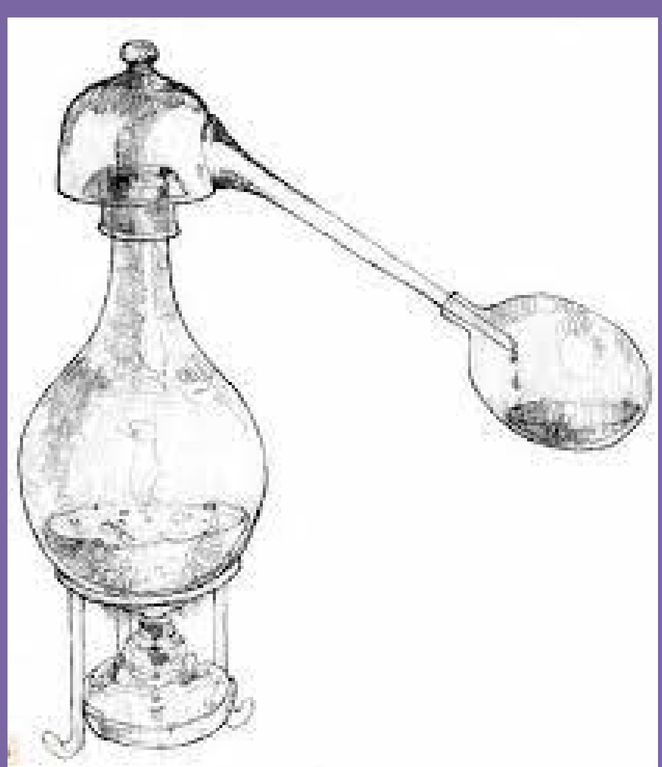
References:
https://www.bbvaopenmind.com/en/science/leading-figures/jabir-ibn-hayyan-great-arab-alchemist/
https://science4fun.info/jabir-ibn-hayyan-geber/

Jabir Ibn Hayyan

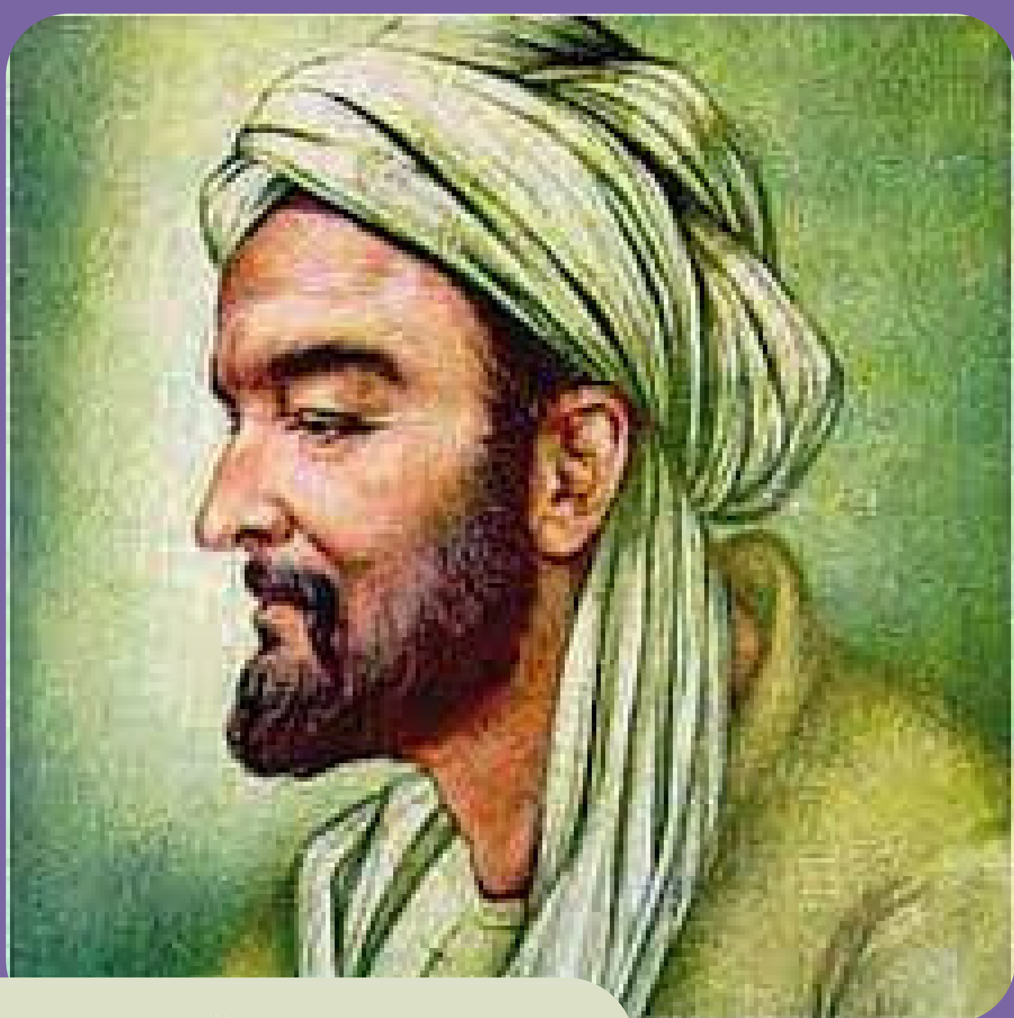
KNOWN AS THE 'FATHER OF ARAB CHEMISTRY'

ABOUT

Jabir Ibn Hayyan, commonly known as the ‘Father of Chemistry’, was born in Persia, which is now known as Iran, in 721 AD. His contributions to chemistry include the findings of several chemical compounds and techniques which are still widely used today. Jabir Ibn Hayyan helped develop several laboratory processes which are routinely carried out in chemistry laboratories: crystallisation, distillation, filtration, and calcination.



Distillation apparatus used by Jabir.



Did you know?

Jabir Ibn Hayyan discovered hydrochloric acid (HCl) and nitric acid (HNO_3)

Using hydrochloric and nitric acids in a 3:1 ratio, he was able to make *aqua regia*, which is a compound that can dissolve gold. This proved to be extremely useful for gold extraction.

He also discovered 'Alkali' (bases), which can make water softer.

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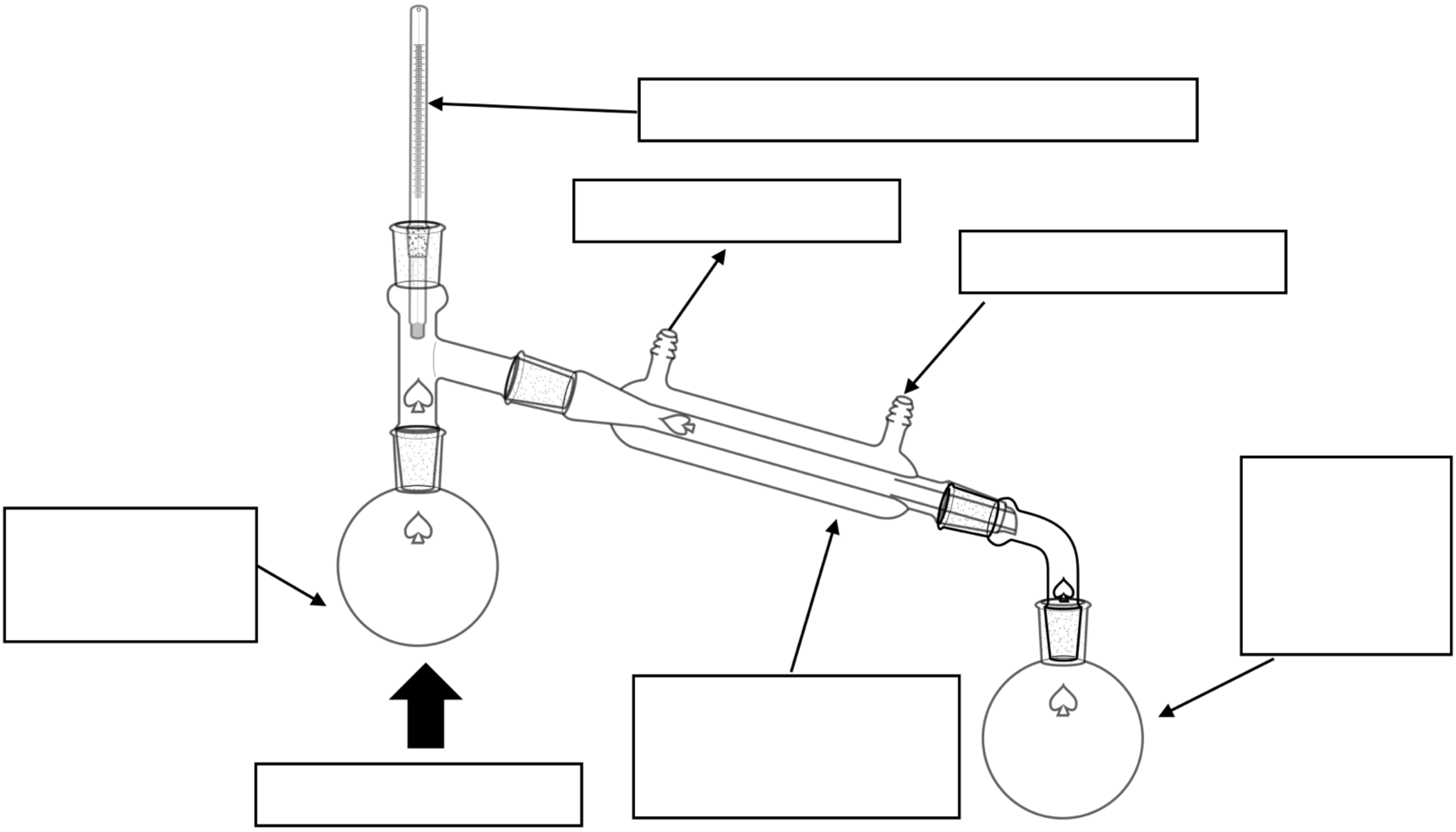
Distillation activity: (easy)

Using the words given in the box below, label the diagram of the distillation apparatus shown below:

Heat, Water in, Thermometer, Distillation flask, Water out, Liebig Condenser, Receiving flask



The early form of distillation was first developed by Jabir Ibn Hayyan (721-851 AD).

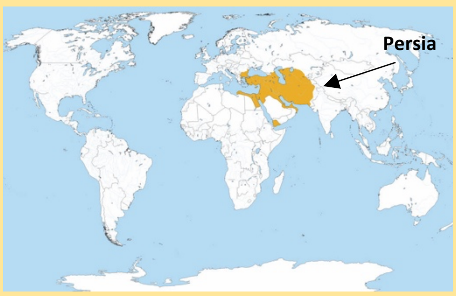


Image above shows Persia on the map of the world.

Image above shows Jabir Ibn Hayyan.

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Distillation activity: (medium)

Label the diagram of the distillation apparatus shown below:

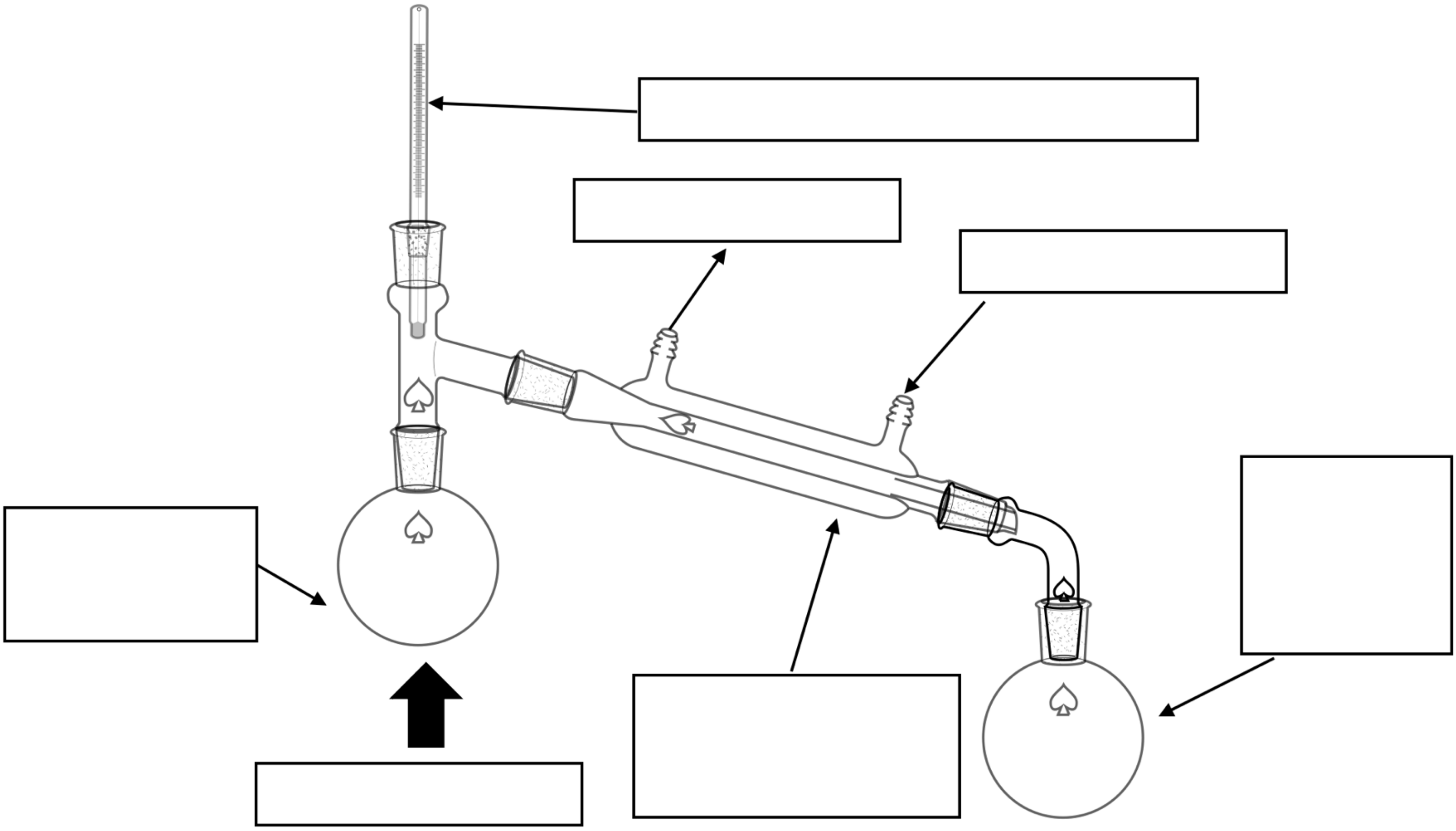

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Image above shows Jabir Ibn Hayyan.

The early form of distillation was first developed by Jabir Ibn Hayyan (721-851 AD).

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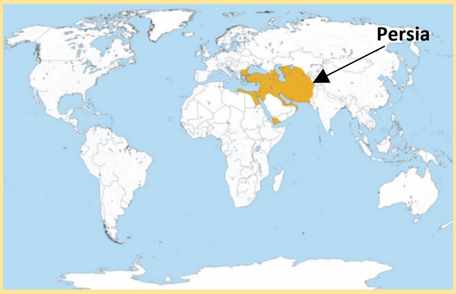
Distillation activity: (hard)

Draw a labelled diagram of the process of distillation in the box below:



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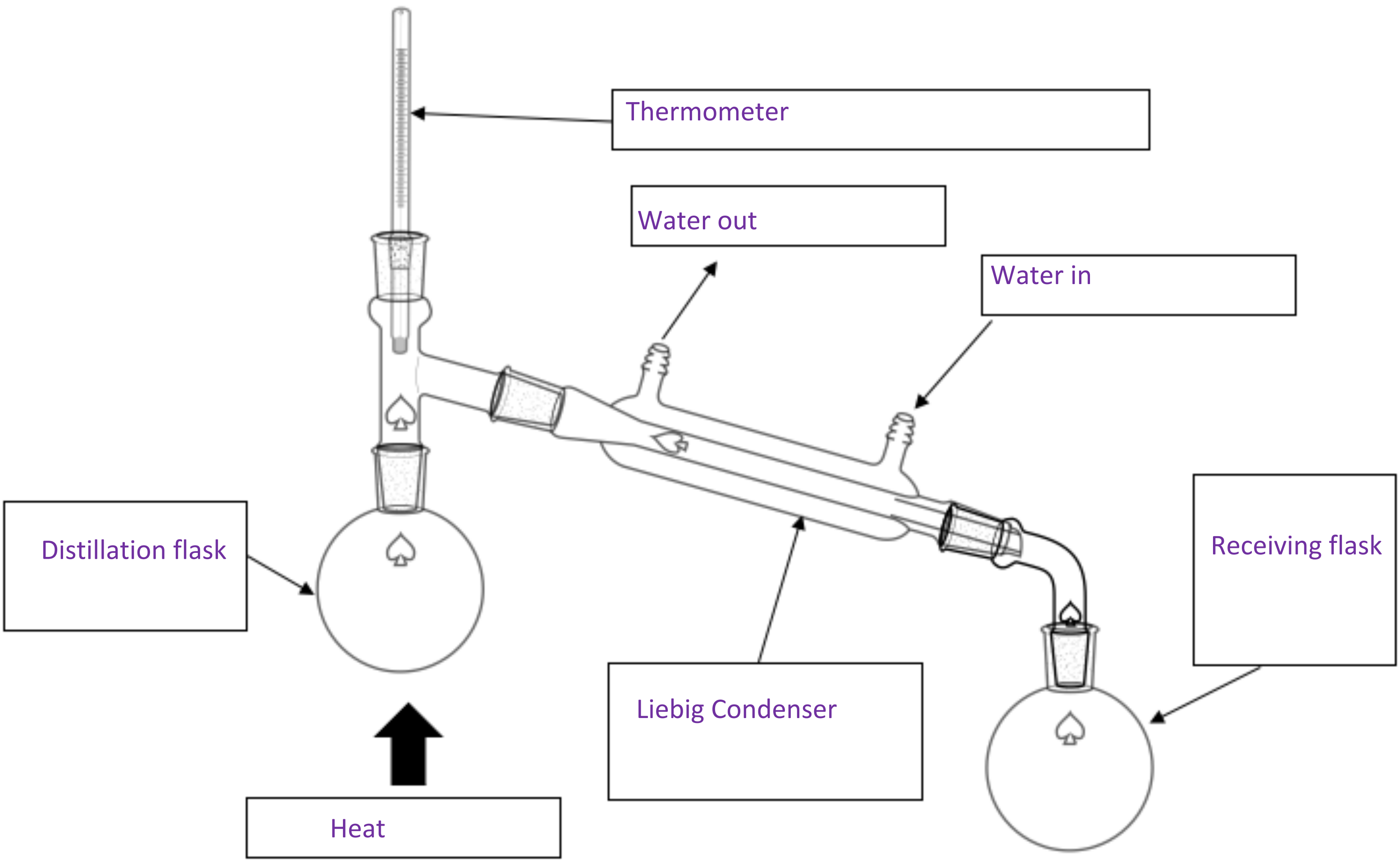
Distillation Activity (answers)



Distillation activity: (easy)

Read the text below and fill in the gaps of the following sentences:

Liquid, boiling point, liquids, Liebig condenser, Bunsen burner, anti-bumping granules, condensation.

Distillation is a process by which two ___________ can be separated. This is done by using their different ____________________________ to boil and condense the liquids. The mixture is heated using a _______________________________. In the distillation flask, _________________________________ are added to ensure the mixture doesn't bubble vigorously. The mixture is heated, and the first liquid will start to evaporate at its boiling point. The cold water will allow the vapour to change into a ________ passing through the ______________________________. This process is called _________________________. The liquid will now be collected in the receiving flask. Water enters from the bottom of the condenser, and it leaves from the top, so the vapour can be cooled efficiently.

Image above shows Persia on the map of the world

Image above shows Jabir Ibn Hayyan

The early form of distillation was first developed by Jabir Ibn Hayyan (721-851 AD)

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Distillation activity: (medium/ hard)

What is distillation?

Where are anti-bumping granules added, and why are they important?

Briefly describe the process of distillation:

Why does water enter from the bottom?

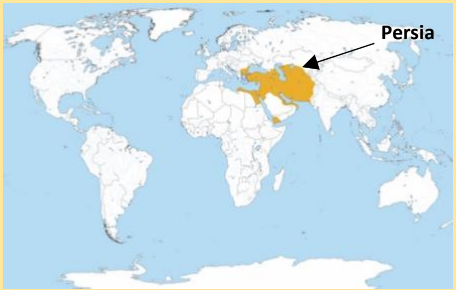

Image above shows Persia on the map of the world

Image above shows Jabir Ibn Hayyan

The early form of distillation was first developed by Jabir Ibn Hayyan (721-851 AD)

Distillation is a process by which two liquids can be separated. This is done by using their different boiling points to boil and condense the liquids. The mixture is heated using a Bunsen burner. In the distillation flask, anti-bumping granules are added to ensure the mixture doesn’t bubble vigorously. The mixture is heated, and the first liquid will start to evaporate at its boiling point. The cold water will allow the vapour to change into a liquid passing through the Liebig condenser. This process is called condensation. The liquid will now be collected in the receiving flask. Water enters from the bottom of the condenser, and it leaves from the top, so the vapour can be cooled efficiently.

What is distillation?

Distillation is a process by which two or more liquids can be separated. This is done by using their different boiling points to boil and condense the liquids.

Where are anti-bumping granules added, and why are they important?

In the distillation flask, anti-bumping granules are added to ensure the mixture doesn't bubble vigorously.

Briefly, describe the process of distillation:

The mixture will be heated, and the first liquid will start to evaporate at its boiling point. The cold water will allow the vapour to change into a liquid in the Liebig condenser. This process is called condensation. The liquid will now be collected in the receiving flask.

Why does water enter from the bottom?

Water enters from the bottom of the condenser, and leaved from the top, so the vapour can be cooled efficiently.