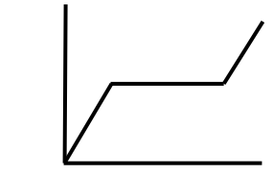
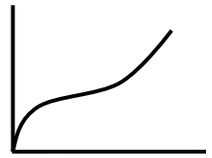
# Combined Science CC1-2 States of Matter and Separating Techniques



*Melting point of a pure substance*



*Melting point of an impure substance*

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| **Pure substances** | ***A pure substances is a single element or compound, not mixed with any other substance.*** | Pure substances melt and boil at specific temperatures. Heating graphs can be used to distinguish pure substances from impure. |

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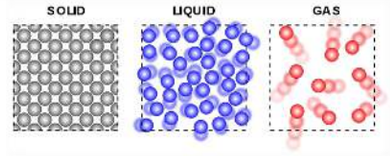
| **Solid, liquid, gas** | ***Melting and freezing happen at melting point, boiling and condensing happen at boiling point.*** |   The amount of energy needed for a state change depends on the strength of forces between particles in the substance. |

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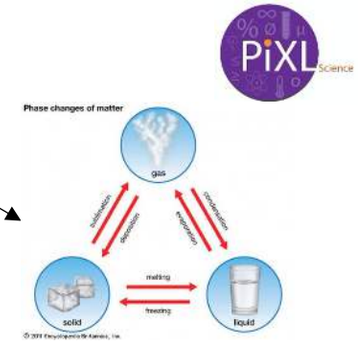
| *s* | **solid** |
| *l* | **liquid** |
| *g* | **gas** |




**States of matter**

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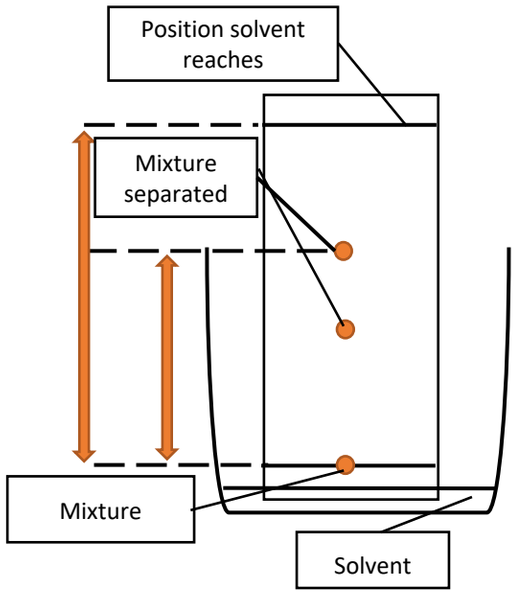
| **Energy and movement** | ***Gas particles have higher levels of energy than liquids and solids*** | **Gas particles move more than the other states of matter, with solids moving the least due to their tightly packed arrangement. Solid particles can only vibrate around their fixed positions.** |

**Pure substances**

**Method of separating substances**




**Chromatography**

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| **Chromatography** | ***Can be used to separate mixtures and help identify substances.*** | Involves a mobile phase (e.g. water or ethanol) and a stationary phase (e.g. chromatography paper). |
| **$R_f$ Values** | ***The ratio of the distance moved by a compound to the distance moved by solvent.*** | $R_f$ = distance moved by substance / distance moved by solvent |
| **Pure substances** | ***The compounds in a mixture separate into different spots.*** | This depends on the solvent used. A pure substance will produce a single spot in all solvents whereas an impure substance will produce multiple spots. |

**Fractional distillation**

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| **Fractions** | ***The hydrocarbons in crude oil can be split into fractions*** | Each fraction contains molecules with a similar number of carbon atoms in them. The process used to do this is called fractional distillation. |
| **Fractional distillation** | ***Crude oil is heated and hydrocarbons boil and condense at certain temperatures*** | This is due to the different lengths of hydrocarbon chains. |

**Simple distillation**

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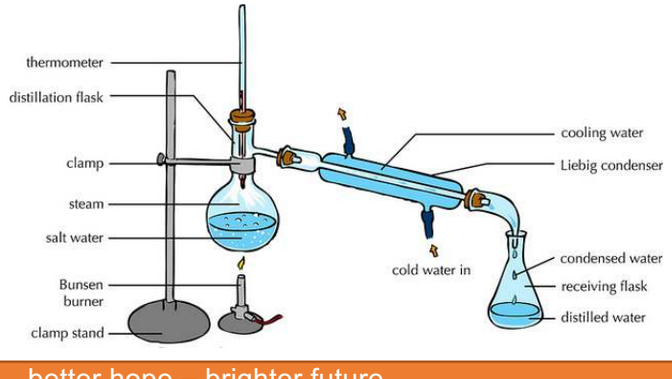
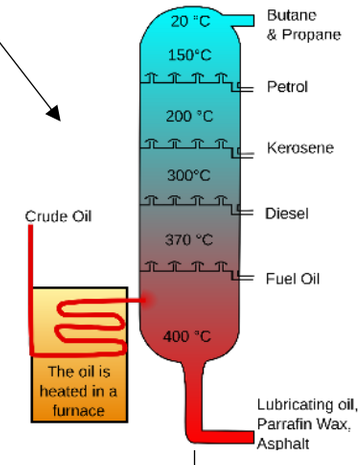
| **Distillation** | ***Used to separate a mixture of liquids*** | **During distillation, the mixture gets heated causing one liquid at a time to evaporate and then condense in the Liebig condenser.** |
| **Boiling points** | ***Each of the liquids in the mixture will have a different boiling point*** | **This enables the liquids to be separated. Distillation can also be used to analyse purity of a substance as pure substances have a sharp boiling point.** |

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| **Using fractions** | ***Fractions can be processed to produce fuels and feedstock for petrochemical industry*** | We depend on many of these fuels; petrol, diesel and kerosene.<br><br>Many useful materials are made by the petrochemical industry; solvents, lubricants and polymers. |

# Combined Science CC1-2 States of Matter and Separating Techniques

## Methods of separating substances

### Filtration

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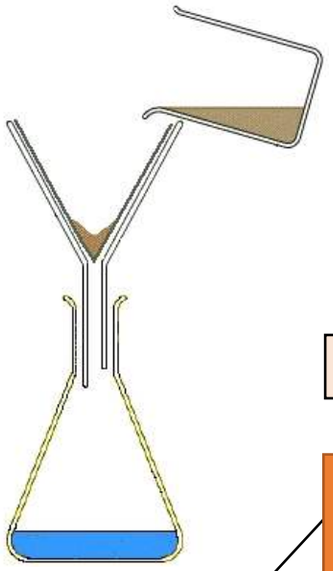
| **Filtration** | *This technique separates substances that are insoluble in a solvent from those that are soluble* | An example is sand in water; the sand will collect in the filter paper and the water will move through the it. |

*The filtrate is the liquid that moves through the filter paper and collects underneath* | The residue is the insoluble solid that collects in the filter paper.



### Crystallisation

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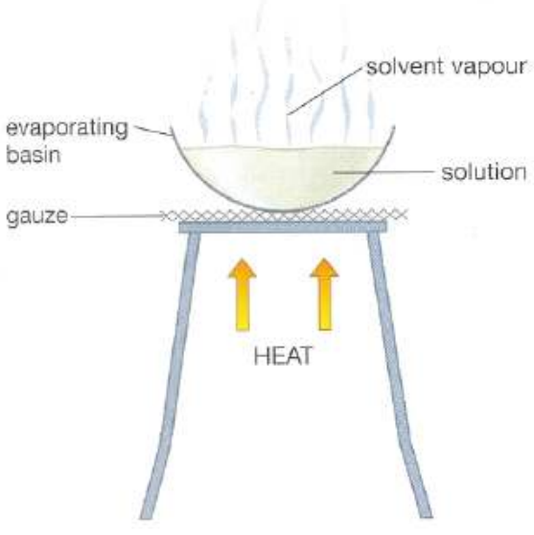
| **Crystallisation** | *This technique separates a soluble substance from a solvent by evaporation* | An example is the crystallisation of sodium chloride from a salt solution. |




## Purifying substances

### Potable water

Sterilising agents include chlorine, ozone and UV light.

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| **Potable water** | *Water of an appropriate quality is essential for life* | Human drinking water should have low levels of dissolved salts and microbes. This is called potable water. |
| **UK water** | *Rain provides water with low levels of dissolved substances* | This water collects in the ground/lakes/rivers. To make potable water an appropriate source is chosen, which is then passed through filter beds and then sterilised. |
| **Desalination** | *Needs to occur is fresh water is limited and salty/sea water is needed for drinking* | This can be achieved by distillation or by using large membranes e.g. reverse osmosis. These processes require large amounts of energy. |

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| **Using water** | *Water used for chemical analysis must not contain any dissolved salts* | Water used for this purpose must be treated in order to be suitable. |
| **Producing potable water** | *There are 4 main steps to producing potable water* | 1. Choosing appropriate source of fresh water<br>2. Sedimentation<br>3. Passing the water through filter beds<br>4. Chlorination |

### Waste water treatment

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| **Waste water** | *Produced from urban lifestyles and industrial processes* | These require treatment before used in the environment. Sewage needs the organic matter and harmful microbes removed. |
| **Sewage treatment** | *Includes many stages* | - Screening and grit removal<br>- Sedimentation to produce sludge and effluent (liquid waste or sewage).<br>- Anaerobic digestion of sludge<br>- Aerobic biological treatment of effluent. |