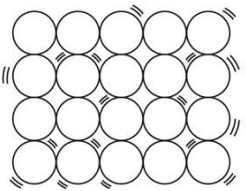
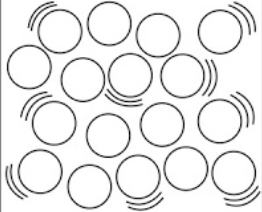
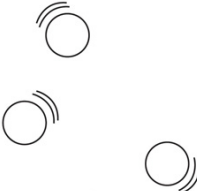


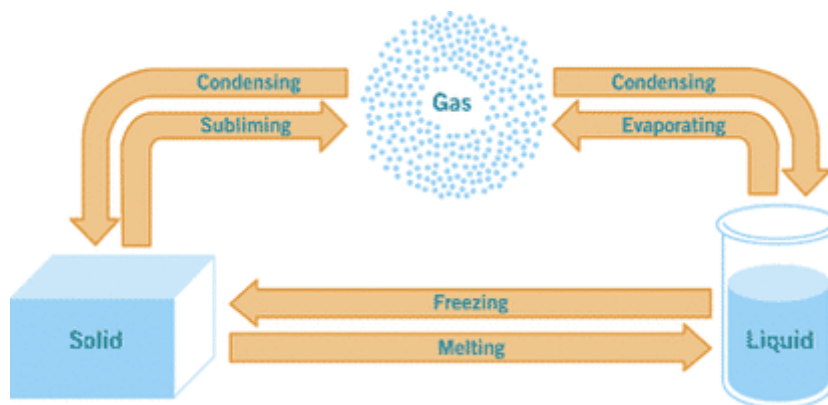
# Unit 1: Particles and Purification

## Solids, Liquids and Gases

- All matter is made up of particles. Three types of particles make up matter:
  1. An atom is the smallest particle that cannot be broken down by chemical means
  2. A molecule is a particle of two or more atoms joined together
  3. An ion is an atom or groups of atoms that carry an electrical charge

<u>Solid</u>		<u>Liquid</u>		<u>Gas</u>	
					
Solid		Liquid		Gas	
Arrangement: fixed pattern		Arrangement: random-no fixed pattern		Arrangement: random	
Movement: only vibrate		Movement: slide past each other		Movement: move everywhere rapidly	
Proximity: close together		Proximity: close together		Proximity: far apart	

## Changing state



## Diffusion

- The kinetic particle theory states that molecules in solids, liquids and gases are constantly moving
- Diffusion is the random movement of particles until evenly spread
- The overall direction of the movement of the particles is from where the particles are more concentrated to where the particles are less concentrated, however, since the particles are moving randomly, some are moving from less concentrated regions to even more concentrated regions
- Diffusion does not occur in solids because of the arrangement of their particles
- Diffusion occurs faster in gases than in liquids because gas particles move more rapidly than liquid particles

- The speed at which diffusion occurs depends on how heavy its molecules are. Lighter molecules diffuse faster than heavier molecules
- The rate of diffusion depends on the relative molecular mass. Substances with a high relative mass diffuse more slowly than those with a low relative molecular mass

### Apparatus for measuring

- In chemistry, mass is measured in grams, temperature in °C and volume in  $cm^3$  or  $dm^3$
- Volume can be measured using:
  1. A volumetric cylinder
  2. A volumetric pipette
  3. A burette
  4. A volumetric flask
- The volume of gases can be measured using a gas syringe or an upturned measuring cylinder (displacement)
- Accuracy depends on:
  1. Using apparatus with small scale divisions
  2. Reading the measurements accurately (no error of parallax)
  3. Repeating measurements to remove anomalies
  4. Using the apparatus carefully

### Paper Chromatography

- Chromatography is a method for separating and purifying colored compounds using filter paper and a solvent
- Chromatography is used to identify compounds
- Locating agents are used to make colorless compounds visible on a chromatogram
- The compounds on a chromatogram can be identified using their  $R_f$  value

$$R_f \text{ value} = \frac{\text{distance from base line to center of the spot}}{\text{distance of solvent front from the base line}}$$

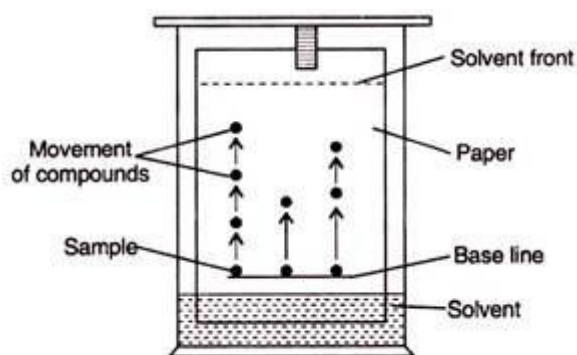


Fig. 23.1.

### Chemical Purity

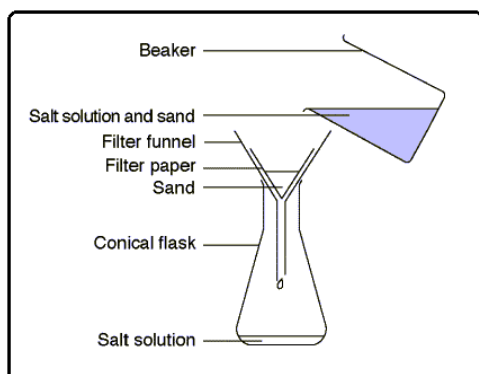
- When chemists talk about purity they mean there is only one substance present
- Medicinal drugs and food additives must be pure to avoid harming people
- The computer industry needs pure silicon to make computer chips, to prevent the chips from not working properly
- The melting point is the temperature at which a substance changes from solid to a liquid

- The boiling point is the temperature at which a solid changes to a liquid
- Melting and boiling points can be used to identify pure substances
- A pure substance melts and boils at a definite temperature
- An impure substance melts and boils over a range of temperatures
- Simple distillation is used to separate water from a dissolved salt
- Fractional distillation is used to separate more volatile liquids from less volatile liquids

### Methods of Purification

- A dissolved solid is called a solute
- The liquid that dissolves in the solute is called a solvent
- Solute + Solvent = Solution
- An undissolved solid can be separated from a solution or liquid by passing it through a piece of filter paper in a funnel. This is called filtration.
- Decanting is to pour off a solution leaving the solid behind
- Centrifuging is used with heavy solids, the machine spins the test tubes at high speeds forcing the solid particles to the bottom so the liquid can be poured off

### Crystallization



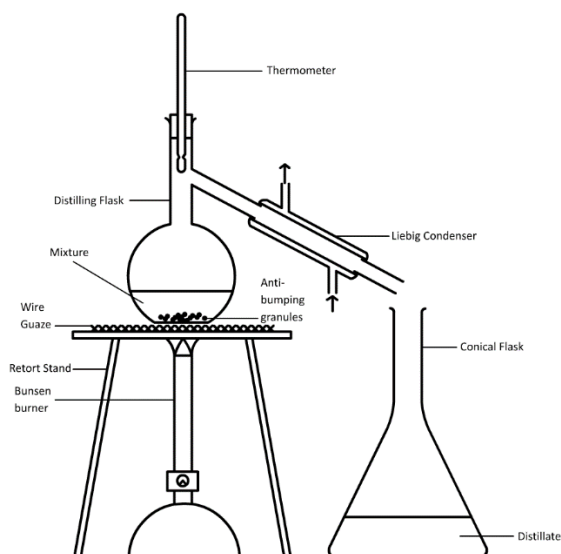
- Step 1: evaporate off some solution to form a saturated solution
- Step 2: leave to cool and crystals will form
- Step 3: Filter crystals
- Step 4: Rinse and Dry

### Solvent Extraction

- Solvent extraction can be used to separate two solutes dissolved in a solvent. This is especially useful if one of the solutes is volatile- evaporates easily. A second solvent is used to extract one of the solids from the first solution. The second solvent must not mix with the first- we say it is immiscible

## Simple Distillation

- Simple distillation is used to obtain a solvent from a solution



## Fractional distillation

- Used to separate mixtures of different boiling points
- Liquids which are immiscible can be separated using this method
- This method is very important for the separation of petroleum fraction and separating water from ethanol
- Fractional distillation uses a tall column in which continuous evaporation and condensation of the liquid occurs
- There is a range of temperature in the column; higher at the bottom and lower at the top. The more volatile liquid evaporates and moves further up the column. This is collected as the distillate.

