Mixtures, Pure Substances and Separating Mixtures

1. A **mixture** consists of two or more elements or compounds not chemically combined together.
2. The chemical properties of each substance in the mixture are unchanged.
3. Mixtures can be separated by physical processes such as **filtration**, **crystallisation**, simple distillation, fractional distillation and chromatography.
4. These **physical processes** do not involve chemical reactions and no new substances are made.
5. Decanting separates large insoluble solids from liquids
6. **Evaporation** separates dissolved solids from their solvent
7. A disadvantage of evaporation is that liquid is lost to the atmosphere
8. In **crystallisation**, the liquid is evaporated to leave behind solid crystals
9. Filtration separates a liquid from an **insoluble** solid
10. The pure liquid collected is called the filtrate
11. In chemistry, a **pure** substance is a single element or compound, not mixed with any other substance.
12. Pure elements and compounds melt and boil at **specific temperatures**.
13. Melting point and boiling point data can be used to distinguish pure substances from mixtures.
14. In everyday language, a pure substance can mean a substance that has had nothing added to it, so it is unadulterated and in its natural state, e.g. pure milk.
15. A **formulation** is a mixture that has been designed as a useful product. Many products are complex mixtures in which each chemical has a particular purpose.
16. Formulations are made by mixing the components in carefully **measured quantities** to ensure that the product has the required **properties**.
17. Formulations include fuels, cleaning agents, paints, medicines, alloys, fertilisers and foods
18. In **distillation**, a solution can be separated by **evaporating** the **solvent**
19. Distillation separates a solvent from a solution by using evaporation
20. The substance collected at the end of the distillation process is called the **distillate**
21. During distillation, a **condenser** cools the hot vapour, causing it to condense into a liquid
22. During distillation, a thermometer measures the temperature of the vapour
23. **Fractional distillation** is a method used to separate a liquid mixture
24. Each part of the mixture to be separated is called a fraction
25. The different fractions in a mixture can be separated due to their different boiling points

Chromatography

26. **Chromatography** is a separation technique used to separate mixtures, especially **coloured pigments** and **dyes**
27. Chromatography can be used to separate mixtures and can give information to help identify substances.
28. Chromatography involves a **stationary phase** and a **mobile phase**.
29. Separation depends on the distribution of substances between the phases.
30. The ratio of the distance moved by a compound (centre of spot from origin) to the distance moved by the solvent can be expressed as its **Rf value**:
31. Rf = distance moved by substance/distance moved by solvent
32. Different compounds have different Rf values in different solvents, which can be used to help identify the compounds.
33. The compounds in a mixture may separate into different spots depending on the solvent but a pure compound will produce a single spot in all solvents.

34. A large Rf value indicates the substance is very soluble in the solvent, and it travels higher up the stationary phase
35. A small Rf value indicates the substance is less soluble in the solvent, and it travels less high up the stationary phase

Testing for Gases

36. The test for **hydrogen** uses a **burning splint** held at the open end of a test tube of the gas. Hydrogen burns rapidly with a pop sound.
37. If a **squeaky pop** is heard, this indicates that hydrogen gas is present
38. The test for **oxygen** uses a **glowing splint** inserted into a test tube of the gas. The splint **relights** in oxygen.
39. If the splint relights, oxygen is present
40. The test for **carbon dioxide** uses an aqueous solution of calcium hydroxide (**limewater**). When carbon dioxide is shaken with or bubbled through limewater the limewater turns **milky** (cloudy).
41. If the limewater turns milky/cloudy, carbon dioxide is present
42. The test for **chlorine** uses litmus paper. When **damp litmus paper** is put into chlorine gas the litmus paper is **bleached** and turns white.
43. If the litmus paper is bleached and turns white, chlorine gas is present

Identifying Ions (Chemistry only)

44. **Flame tests** can be used to identify some metal ions (cations). Lithium, sodium, potassium, calcium and copper compounds produce distinctive colours in flame tests:
    - **Lithium** compounds result in a **crimson** flame
    - **Sodium** compounds result in a **yellow** flame
    - **Potassium** compounds result in a **lilac** flame
    - **Calcium** compounds result in an **orange-red** flame
    - **Copper** compounds result in a **green** flame.
45. If a sample containing a mixture of ions is used some flame colours can be **masked**.
46. **Sodium hydroxide solution** can be used to identify some metal ions (cations).
47. Solutions of **aluminium**, **calcium** and **magnesium** ions form **white precipitates** when sodium hydroxide solution is added but only the aluminium hydroxide precipitate **dissolves** in excess sodium hydroxide solution.
48. Solutions of copper(II), iron(II) and iron(III) ions form coloured precipitates when sodium hydroxide solution is added.
49. **Copper**(II) forms a **blue** precipitate, **iron(II)** a **green** precipitate and i**ron(III)** a **brown** precipitate.
50. **Carbonates** react with **dilute acids** to form **carbon dioxide gas**. Carbon dioxide can be identified with **limewater**.
51. **Halide** ions in solution produce precipitates with silver nitrate solution in the presence of dilute nitric acid
    - Silver **chloride** is **white**
    - Silver **bromide** is **cream**
    - Silver **iodide** is **yellow**
52. **Sulfate** ions in solution produce a **white precipitate** with **barium chloride** solution in the presence of dilute hydrochloric acid.
53. Elements and compounds can be detected and identified using **instrumental methods**.
54. Instrumental methods are accurate, sensitive and rapid.
55. **Flame emission spectroscopy** is an example of an instrumental method used to analyse metal ions in solutions.
56. The sample is put into a flame and the light given out is passed through a spectroscope.
57. The output is a line spectrum that can be analysed to identify the metal ions in the solution and measure their concentrations.