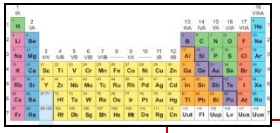
# Year  Atomic Structure and Periodic Table Foundation

## Today

- Elements with similar properties arranged in groups
- Based on properties
- All have the same number of electrons in the outer shell

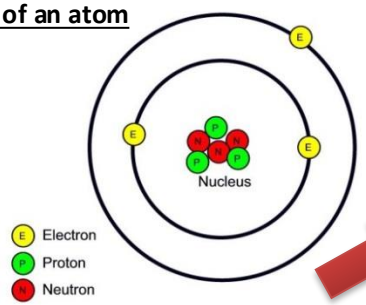
## Modern periodic table

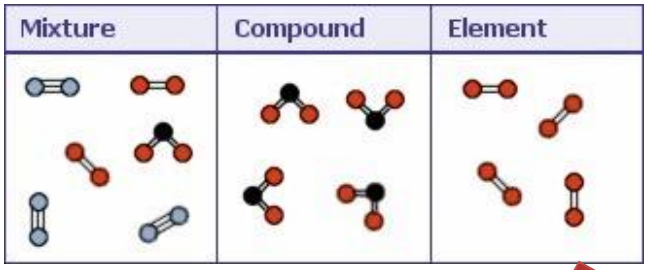
The arrangement of elements in a table based on proton number, properties and outer electron number

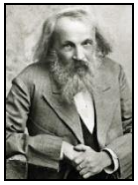


START

## Structure of an atom



## Mendeleev

Overcame the problems of atomic weight.  He did this by;

- Leaving gaps
- Changing the order of the elements
- Predicted elements were discovered
- Differences were accounted for by isotopes

## Early tables

- First attempts to classify elements were made before subatomic particles were discovered
- John Newlands ordered the elements based on atomic weight
- Wrong groups used

## Development of the periodic table

As more elements were discovered scientist tried to classify them

**Keywords:**

1. **Atom:** The smallest part of an element – everything is made up of atoms
2. **Element:** a substance made up of only one type of atom – cannot be broken down into simpler substances
3. **Compound:** 2 or more elements that are chemically combined
4. **Mixture:** contains two or more substances that are NOT chemically combined and can be separated
5. **Filtration:** Method of separating soluble and insoluble substances
6. **Crystallisation**: separation technique where a liquid is removed, leaving a solid behind
7. **Chromatography:** method of separating solutions dissolved in the same solvent
8. **Simple Distillation:** method of separating a liquid from its solvent
9. **Fractional Distillation:** separating a mixture into a number of different parts based on boiling points

**Word equations:**

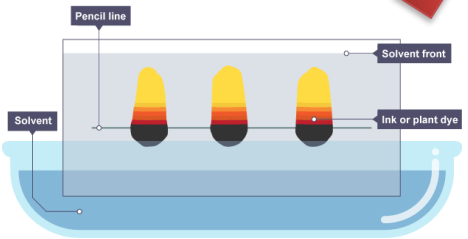
Reactants -> Products

Three parts to a word equation:

1. Name of reactants
2. An arrow
3. Name of products

e.g. reaction between hydrogen and oxygen:

Oxygen + hydrogen -> water

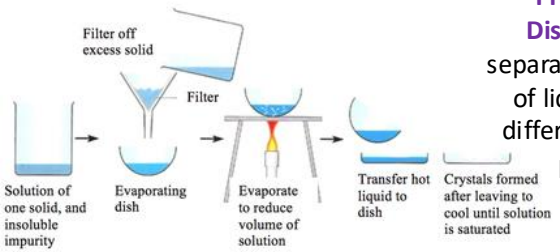



## Mixtures

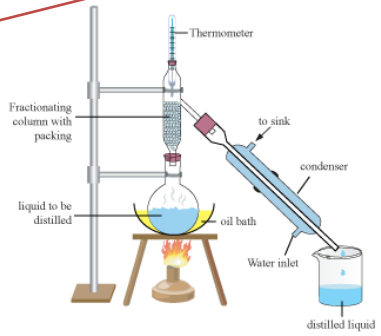
Contain elements that are not chemically combined – they can be separated by these methods:

**Chromatography:** separate mixtures of coloured compounds

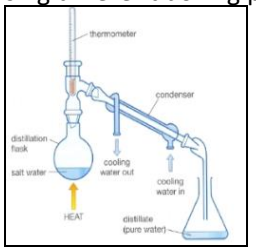
**Crystallisation:** separate a solid that has dissolved in a liquid



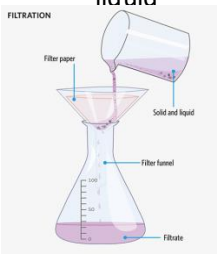

**Fractional Distillation:** separate a mixture of liquids with different boiling points

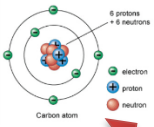



**Simple Distillation:** separate a liquid from its solvent using different boiling points




**Filtration:** separate an insoluble solid from a liquid



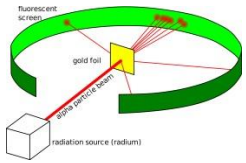



## Niels Bohr

Adapted the nuclear model suggesting electrons in orbitals at set distance

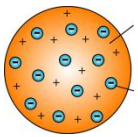
## Nucleus development

This experiment allowed Rutherford to replace the plum pudding model with the nuclear model – the atom was mainly empty space with a small positively charged nucleus




## Alpha particle scattering

Geiger and Marsden fired positively-charged alpha particles at gold foil. This showed that the mas of an atom was concentrated in the centre, it was positively charged too



## Plum pudding

After the electron was discovered, Thomson created the plum pudding model – the atom was a ball of positive charge with negative electrons scattered in it

## Early ideas

Before the discovery of the electron, Dalton thought that atoms were tiny spheres, that couldn't be divided

## Development of the model of the atom

New experimental evidence may lead to the model being changed or replaced

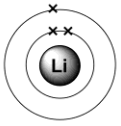
CONTINUE

## Group 1

- Alkali metals
- 1 outer electron
- Reactivity increases going down the group


**Alkali Metal Reactions:**

- Alkali Metal + Oxygen -> Alkali Metal Oxide
- Alkali Metal + Water -> Alkali Metal Hydroxide + Hydrogen

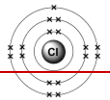



## Group 7

- Halogens
- 7 outer electrons
- Non-metals
- Molecules made of pairs of atoms

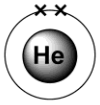
React with metals to form ionic compounds

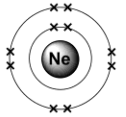
React with non-metals to form covalent compounds




**Displacement:**

- Halogens react with other substances to form halides
- A more reactive halogen will always displace ("push out") a less reactive halide from its compounds in solution
- e.g. Chlorine + Potassium Bromide -> Potassium Chloride + Bromine



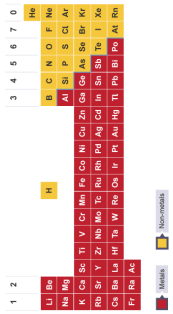




## Group 0

- Noble gases
- Unreactive/ stable – full outer shell of electrons
- Don't form molecules easily
- Boiling point increases going down group

**Keywords:**

1. **Atomic Number**: number of protons (which is equal to number of electrons) in an atom
2. **Atomic Mass Number:** number of protons + neutrons in the nucleus of an atom
3. **Proton:** Positively charged subatomic particle in the nucleus of an atom
4. **Neutron:** Subatomic particle in the nucleus of an atom with no charge
5. **Electron:** Negatively charged subatomic particle orbiting the nucleus of an atom
6. **Isotope:** atoms that have the same number of protons and electrons but a different number of neutrons
7. **Ion:** An atom that has gained an electron is a negative ion (non-metal) and atom that has lost an electron is a positive ion (metal)
8. **Group:** column number in periodic table representing number of electrons on outer shell
9. **Period:** row number in periodic table representing number of electron shells




## Metals

Majority of elements are metals

Form positive ions

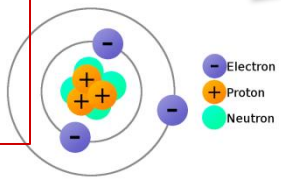
Found on left hand side, middle and bottom of table

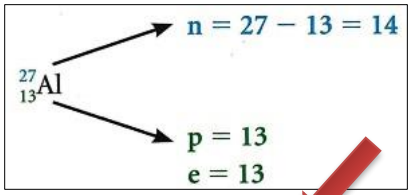
## Non-metals

- Form negative ions
- Found on right hand side and top of table

(Mass number) 23

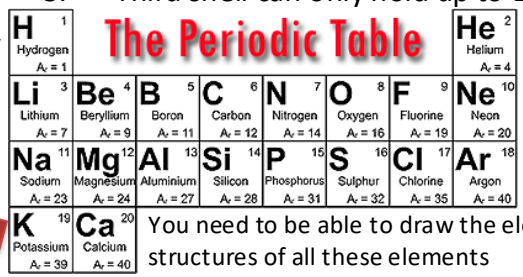
(Atomic number) 11 Na



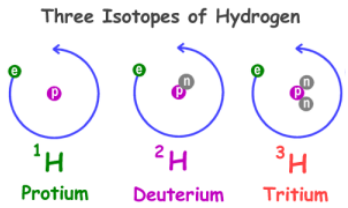




**Rules for filling electron shells:**

1. First shell can only hold up to 2 electrons
2. Second shell can only hold up to 8 electrons
3. Third shell can only hold up to 18 electrons




You need to be able to draw the electron structures of all these elements




## Isotopes

These are all isotopes of hydrogen

They all have the same number of protons **but** different numbers of neutrons

| Subatomic particle | Relative charge | Relative mass |
|---|---|---|
| Proton | +1 | 1 |
| Neutron | 0 | 1 |
| Electron | -1 | Very Small |

# Questions

1. Draw an atom and label the protons, neutrons and electrons
2. Describe the difference between an element and a compound
3. Name the 3 key parts in a word equation
4. $2H_2 + O_2 \rightarrow 2H_2O$ What are the reactants in this equation? What are the products? How many atoms are there in total? Which elements are in this reaction?
5. Name the 5 processes for separating mixtures
6. How was the periodic table first ordered?
7. Why were early versions of the periodic table changed?
8. Describe 2 changes Mendeleev made to the periodic table
9. Describe one similarity and one difference between Mendeleev's and Newlands' periodic table
10. What does the group number in the periodic table mean?
11. How are the elements arranged in the modern periodic table?
12. Draw the electron structure for sodium, lithium and potassium
13. What is the electron structure for the alkali metals?
14. List the alkali metals in order from least reactive to most reactive
15. Write out the word equation for the reaction between oxygen and
    (i) sodium (ii) lithium (iii) potassium
16. Write out the word equation for the reaction between water and
    (i) sodium (ii) lithium (iii) potassium

17. Draw the electron structure for fluorine, chlorine and bromine
18. Describe the rule of displacement
19. Would bromine displace potassium bromide? Why?
20. Would iodine displace potassium bromide? Why?
21. Describe 3 properties of the noble gases
22. Use the electron structure of the noble gases to explain why they are unreactive
23. Describe the difference in formation of ions between metals and non-metals
24. Describe the mass, charge and location of the neutrons, protons and electrons
25. Draw the electron structure for the first 12 elements in the periodic table
26. Describe 3 differences between the plum pudding model and the nuclear model
27. Describe 2 similarities between the plum pudding model and the nuclear model