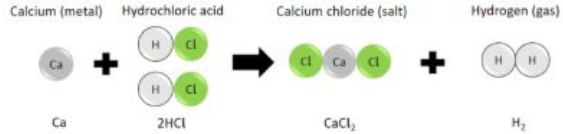
Reactivity Knowledge Organiser

Topic Overview

Metals and acids

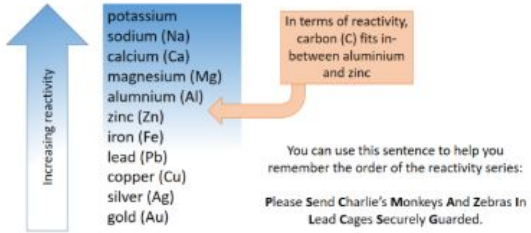
- When a metal reacts with an acid, bubbles of gas are seen. This gas ignites in the presence of a lit splint – this shows that it is **hydrogen**.
- The remaining atoms join to make a **metal salt**.
- This can be shown by a diagram:



- The general word equation for this reaction is: **metal + acid → metal salt + hydrogen**.
- The name of the salt produced depends on the metal and acid used. For example:
  - magnesium + hydrochloric acid → magnesium chloride + hydrogen
  - calcium + nitric acid → calcium nitrate + hydrogen
  - zinc + sulfuric acid → zinc sulfate + hydrogen

Reactivity

- **Reactivity** is how easily a substance reacts with other chemicals.
- The **reactivity series** lists substances in order of their reactivity:



You can use this sentence to help you remember the order of the reactivity series:

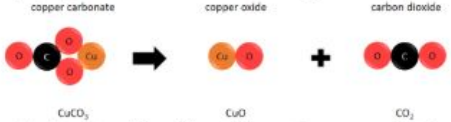
Please **S**end **C**harlie's **M**onkeys **A**nd **Z**ebras **I**n **L**ead **C**ages **S**ecurely **G**uarded.

- You can use the reactivity series to predict whether a reaction will take place or not.

Thermal decomposition

- A thermal decomposition reaction is one in which a single reactant is broken down into simpler products by heating.
- The general word equation for this reaction is: **metal carbonate → metal oxide + carbon dioxide.**
- You can tell that carbon dioxide has been produced as the **limewater turns cloudy**.

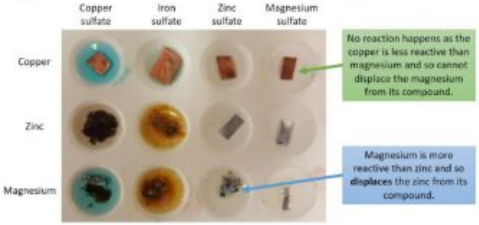
- For example, copper carbonate breaks down into copper oxide and carbon dioxide:



- Not all metal carbonates will break down this way: the more reactive the metal in the compound, the harder it is to break down.

Displacement reactions

- In a displacement reaction a more reactive element will replace a less reactive element in a compound.
- The further apart the metals are in the reactivity series, the bigger the reaction will be e.g. copper sulfate and magnesium gets hotter than copper sulfate and iron.



- The reaction in the diagram above can be summarised as:

zinc sulfate + magnesium → magnesium sulfate + zinc

Extracting metals

- The Earth's crust contains many **natural resources** which are substances which act as raw materials for making a variety of products.
- Only a few metals, such as gold, are found pure in the ground, others exist as **minerals** (compounds) and must therefore be **extracted**. A rock that contains enough of the mineral to make extraction worthwhile is called an **ore**.
- **Displacement reactions using carbon** are used to extract metals whose reactivity is lower than aluminium.
- **Electrolysis** (a process in which an electrical current is used to split a compound into simpler substances) is used to extract metals whose reactivity is higher than zinc. Electrolysis requires a lot of energy and so is expensive. Recycling is much cheaper.

Recycling

- **Recycling** is when an object is processed so that the materials it is made from can be used again.
- Recycling is important as it reduces the need to extract resources from the crust. It also saves energy and reduces the amount of rubbish thrown away into landfill.

Reactivity Key Fact Test 1-10

No	Questions	Answers	☑
1	What are the products of a reaction between a metal and an acid?	Metal salt and hydrogen	
2	What is the general equation for a metal reacting with acid?	Metal + Acid → Metal salt + Hydrogen	
3	What do we call a list of metals placed in order of how reactive they are?	The reactivity series	
4	What is the order of metals in the reactivity series, starting with the most reactive?	Potassium, sodium, calcium, magnesium, aluminium, zinc, iron, lead, copper, silver, gold	
5	What do we call a reaction where a compound is broken down using heat?	Thermal decomposition	
6	What gas is produced in the thermal decomposition of a metal carbonate?	Carbon dioxide	
7	What is the general equation for the thermal decomposition of metal carbonates?	Metal carbonate $\xrightarrow{\text{(heat)}}$ Metal oxide + Carbon dioxide	
8	What do we call a reaction where a more reactive metal takes the place of a less reactive metal in a compound?	A displacement reaction	
9	Why does zinc react with copper sulfate and what is the word equation for this reaction?	Zinc is more reactive so displaces the copper. (Zinc + copper sulfate → zinc sulfate + copper)	
10	Why is there no reaction between magnesium sulfate and iron?	Iron is less reactive than magnesium so cannot displace the magnesium	

Reactivity Key Fact Test 11-20

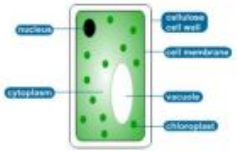
No	Questions	Answers	☑
11	What do we call substances from the Earth which act as raw materials for making a variety of products?	Natural resources	
12	What do we call a naturally occurring metal compound?	A **mineral**	
13	What do we call a naturally occurring rock from which minerals can be extracted?	An **ore**	
14	Where can carbon be placed in the reactivity series?	Between aluminium and zinc	
15	Why can zinc, iron, lead and copper be extracted from their ores by heating them with carbon?	Because these metals are lower than carbon in the reactivity series	
16	What process can be used to extract metals which are more reactive than carbon?	Electrolysis	
17	What happens during electrolysis?	Electrical current is used to split a compound into simpler substances	
18	What do we call the processing of a material so it can be used again?	Recycling	
19	Name some materials that can be recycled.	Metal, glass, plastic, cardboard, paper	
20	Why is it important to recycle materials?	• It reduces the need to extract resources from the Earth's crust • It saves energy • It reduces the amount of rubbish thrown away into landfill	

Photosynthesis

Keyword	Definition
Photosynthesis	Process carried out where plants make their own food. Carbon Dioxide + Water → Glucose + Oxygen
Chlorophyll	Green pigment in chloroplasts of plant cells. It enables photosynthesis to take place.
Chloroplasts	Contain the green pigment chlorophyll; the site of photosynthesis.
Waxy Cuticle	Waxy layer, prevents water loss.
Upper Epidermis	Thin and transparent allowing light to pass through.
Palisade Mesophyll	Main region for photosynthesis. Lots of palisade cells containing lots of chloroplasts.
Spongy Mesophyll	Cells are more loosely packed. Contains air spaces between cells allowing gas exchange.
Lower Epidermis	Contains stomata to regulate the loss of water vapour (transpiration)
Stomata	Each stomata surrounded by a pair of guard cells. Guard cells control whether they're open or closed.
Petals	Brightly coloured to attract insects.
Stamen	The male part of the flower (each consist of an anther held up on a filament)
Stigma	The top of the female part of the flower which attracts pollen.
Anthers	Produce make sex cells (pollen grains)
Ovary	Produces the female sex cells (contained in the ovules)
Nectary	Produce a sugary solution called nectar, which attracts insects.

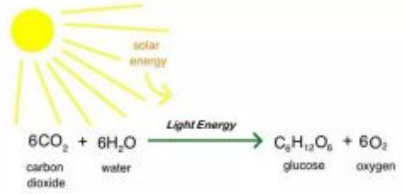
Green plants and algae do not eat food to get their energy, Instead they make their own food by a process called photosynthesis.
Photosynthesis takes place inside plant cells within the chloroplasts.

Below shows a diagram of a plant cell.



Chloroplasts contain a green pigment called chlorophyll. This absorbs light energy needed for photosynthesis to occur.

Plants use the raw materials; Carbon Dioxide and Water. With the presence of light energy from the sun, the raw materials are converted into Glucose and Oxygen.



This plant is deficient in nitrate ions. There is poor grown and yellow leaves. Nitrate ions are needed to build proteins and to help the plant grow.

This plant is deficient in phosphate ions. Phosphate ions are needed to ensure good root growth.

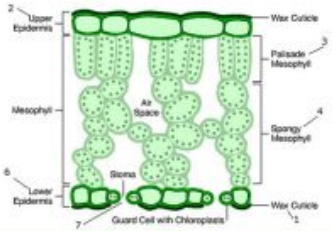
The leaves are starting to turn purple.

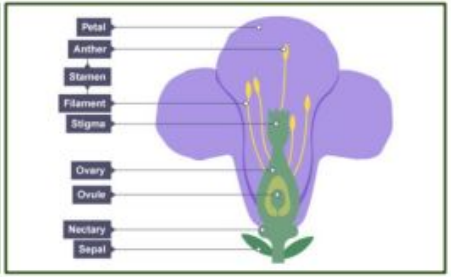
This plant is deficient in Magnesium ions. Yellow leaves start to form, so rate of photosynthesis is reduced. Magnesium ions are needed for photosynthesis.

This plant is deficient in Potassium ions. Potassium ions are needed for making flowers and fruit.

The leaves are turning yellow, with dead spots.

The Leaf Structure





Photosynthesis

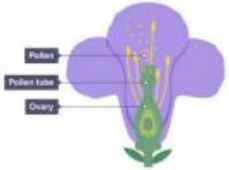
Pollination

During plant reproduction, pollen grains need to move from the anther of one flower to the stigma of another flower. This is called pollination. Pollination can occur by either insects or the wind.

Feature	Insect-pollinated	Wind-pollinated
Petals	Large and brightly-coloured – to attract insects	Small, often dull green or brown – no need to attract insects
Scent and nectar	Usually scented and with nectar – to attract insects	No scent or nectar – no need to attract insects
Number of pollen grains	Moderate - insects transfer pollen grains efficiently	Large amounts – most pollen grains are not transferred to another flower
Pollen grains	Sticky or spiky - sticks to insects well	Smooth and light – easily carried by the wind without clumping together
Anthers	Inside flower, stiff and firmly attached - to brush against insects	Outside flower, loose on long filaments – to release pollen grains easily
Stigma	Inside flower, sticky - pollen grains stick to it when an insect brushes past	Outside flower, feathery – form a network to catch drifting pollen grains

Fertilisation

After pollination the pollen makes a pollen tube down the style to the ovary. The nucleus of the pollen cell travels down the tube to the ovum – when the cell join, this is fertilisation. The cell made when the pollen and ovum fuse will become the seed, which can become a new plant. Plants then form fruits, often from the ovary walls.



Further Reading:

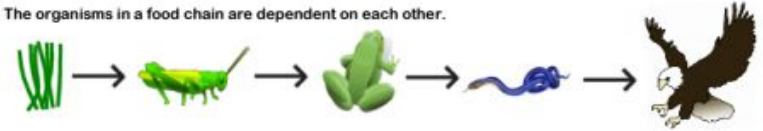
Seed Dispersal

Plants compete with each other for factors including light, water, space, minerals in the soil. Seeds must be dispersed or spread away from each other and from the parent plant. This is to reduce competition between parent plant and new plants.

Method	Detail	Examples
Wind	Seeds have lightweight parts, wings or parachutes	Dandelion, sycamore
Animals (inside)	Brightly coloured and tasty fruits contain seeds with indigestible coats, so that the seeds pass through the animal's digestive system undamaged	Tomato, plum, raspberry, grape
Animals (outside)	Fruits have hooks that attach them to the fur of passing animals	Goose grass, burdock
Self-propelled	Have a pod that bursts open when ripe, throwing the seeds away from the plant	Pea pod

Food Webs & Interdependence

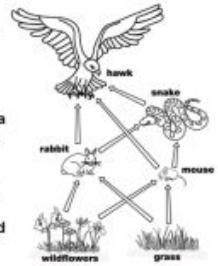
The organisms in a food chain are dependent on each other.



For example, grass is eaten by the caterpillar, which eaten by the frog, which is eaten by the snake, which in turn is hunted by the bird.

The grass is the producer in this food chain, and producers are at the start of all food chains. The grass captures the energy from the sunlight to photosynthesise and make glucose. The glucose provides energy for the grass to grow. When the caterpillar eats the grass, some of the energy left in the grass is transferred to the caterpillar. This energy is passed down the food chain.

Changes in the number of one organism in an area – its population can affect other organisms in the same food chain.
The number of plants in an area can be affected by the amount of rain, sunlight, minerals and space available to grow.
The number of animals can be affected by the availability of food habitats, mates, water and disease.



If the population of mice caught a disease, then there would be more competition between the Hawk and Snake to catch the Rabbit. This could then cause the number of Rabbits to decrease.

Respiration

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Keyword	Definition
Respiration	Process in living things which oxygen is used to release the energy from food. Glucose + Oxygen → Carbon Dioxide + Water (+energy)
Aerobic Respiration	Respiration that requires oxygen.
Anaerobic Respiration	Respiration without oxygen.
Lactic Acid	A chemical produced during anaerobic respiration
Mitochondria	Structures in the cytoplasm of all cells where aerobic respiration takes place.
Oxygen Debt	The amount of extra oxygen required by the body for recovery after vigorous exercise.
Alveoli	Tiny air sacs in the lungs, where gas is exchanged during breathing.
Bronchi	Branches off the trachea that distribute air to both lungs.
Bronchioles	Branches of the bronchi, that distribute the inhaled air throughout all of the lungs.
Diaphragm	Expands and moves down so lungs have room to fill with air – inhalation. Contracts and moves upwards to force air out of the lungs (exhalation).
Lung	Soft organ that inflates to draw in oxygenated air and deflates to expel air.
Trachea	Windpipe, air passes between mouth and lungs.

Aerobic Respiration

Respiration is a series of reactions that takes place in the cells of animals and plants.
Energy is released in the reaction. The mitochondria, found in the cell cytoplasm, is where respiration happens.

Glucose + Oxygen → Carbon Dioxide + Water (+energy)

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

'Energy' is in brackets because it is not a substance. This type of respiration, where oxygen is used, is known as aerobic respiration. Oxygen (from breathing) is carried from the lungs to all the cells of the body in the blood. The waste products (carbon dioxide and water) are taken away from the cells by the blood and breathed out from the lungs.

Anaerobic Respiration

Although anaerobic respiration does release some energy, it does not release as much as aerobic respiration does.

Glucose → Lactic Acid (+energy)

The lactic acid produced during anaerobic respiration builds up in muscles. This can be felt as an aching in muscles during or after exercise.

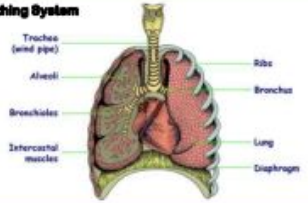
Anaerobic Respiration in Microbes

Anaerobic respiration happens in microorganisms such as bacteria because they need to release energy from glucose. Yeast (unicellular fungi), carry out a process called fermentation.

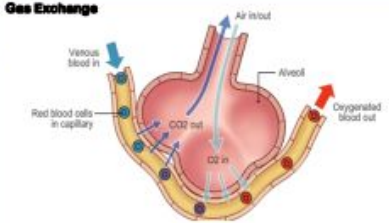
Glucose → Ethanol + Carbon Dioxide

The ethanol (alcohol) is useful for brewers, and carbon dioxide is useful to bakers because it helps their bread rise.

The Breathing System



Gas Exchange



The alveoli are adapted to make gas exchange in the lungs happen easily and efficiently.

- Alveoli give the lungs a large surface area.
- Alveoli have think cells walls (just one cell thick)
- Alveoli are surrounded by lots of blood capillaries.

The gases move by diffusion from where they have a high concentration to a lower concentration.

Oxygen diffuses from the air in the alveoli into the blood.
Carbon dioxide diffuses from the blood into the air in the alveoli.

Asthma and Respiration

Air passage for people who are asthmatic become reduced.

This is why they often struggle during exercise as there is reduced volume of oxygen getting into the blood stream, so rate of respiration is reduced.

KNOWLEDGE ORGANISER - Literacy

Key Word	Definition
accuracy	A measurement is accurate if it is close to the true value
data	Information that has been collected. Data could be qualitative (described using words e.g universal indicator has turned blue) or quantitative (described using numbers e.g. the alkali is at pH 9)
anomalies	Values that you have collected that do not fit the pattern that you have observed. These could be due to error.
fair test	An experiment where only the independent variable has been allowed to affect the dependent variable.
precise	Precise measurements are very similar to the mean value.
range	The maximum and minimum values recorded e.g. from 5cm to 55cm
repeatable	If the same person can follow the same method to obtain the same results.
reproducible	If another person, or the same person using different equipment or techniques, can obtain the same results by repeating an investigation.
resolution	The smallest change in the value being measured by a piece of equipment that can give a change in the reading e.g. rulers have a resolution of 1mm.
variables	Factors that can change in an experiment. An investigation will have an independent, a dependent and control variables.

Example investigation: Investigating how changing the height of a ramp affects the time taken for a car to travel down the ramp.

In an investigation there will be three types of variables:

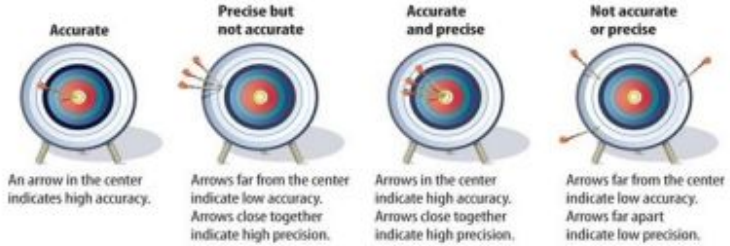
Independent variable: The thing that you choose to change in an investigation.
E.g. The height of a ramp
There will only be **one** independent variable in a fair test

Dependent variable: The thing that you are measuring in an investigation
e.g. the time taken for the car to travel down a ramp

Control variables: These are kept the same as they could affect the results of the investigation. There will be several control variables in an investigation e.g.

- The length of the ramp
- The material the ramp is made of
- The material of the tyres on the car

The diagram shows the difference between values that are accurate and precise. In an experiment, scientists want their results to be both accurate (close to the true value) and precise (close to the mean average).



Scientific Skills Knowledge Organiser

Types of Variable

Independent – the variable that is **changed**

Dependent – the variable that is **measured**

Control – the variable that stays the **same**

Types of Data

Categoric – values that are labels e.g. type of plant

Continuous – values that are numbers e.g. temperature

Tables

Units **only** go in headings

Time (s)	Vol. gas (cm^3)

Types of Error

Systematic – a problem with the method or equipment used. E.g. using a beaker to measure the volume of a liquid instead of a measuring cylinder.

The effect cannot be reduced by taking repeat readings.

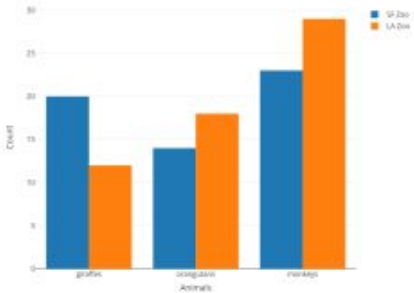
Random – whenever something is measured a random error is made. E.g measuring with a ruler.

The effect can be reduced by taking repeat readings.

Zero – caused by a piece of equipment not reading zero when it should. E.g. a balance. Either reset the piece of equipment or deduct the false reading from all measurements.

Bar Chart

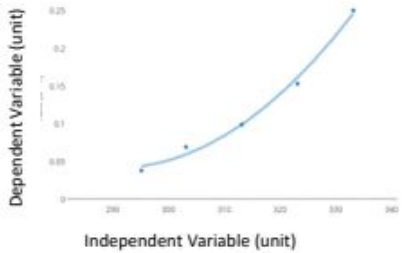
Type of graph plotted for one piece of **categoric** data and one piece of **continuous** data



Line Graph

Type of graph plotted for two pieces of **continuous** data

Has a **line of best fit**. This may be a **straight line** or a **curve** (not join the dots)



Key words

Accurate – close to the true value

Anomalous – a result that doesn't fit the pattern

Precise – small amount of spread around the mean

Resolution – the smallest reading on a piece of measuring equipment

Reproducible – if the same results are obtained by different people for the same investigation

Range – the biggest and smallest values of the independent or dependent variable e.g. 0-10 N

Volume – amount of a liquid

B1 Cell Biology

	Question	Answer
1	Name 5 sub-cellular structures that both animal and plant cells have	Nucleus, cytoplasm, cell membrane, mitochondria and ribosomes
2	State the function of the nucleus.	Controls all activities of the cell, contains genetic information
3	State three differences between animal and plant cells.	Plant cells have chloroplasts, permanent vacuole and cellulose cell wall.
4	What type of organisms are bacteria - prokaryotes or eukaryotes?	Prokaryotes
5	Prokaryotes have a cell wall. True or false?	TRUE
6	Where does the genetic material of a prokaryotic cell exist?	Cytoplasm
7	Why do sperm cells have lots of mitochondria?	To provide lots of energy for swimming
8	Describe the adaptations of a nerve cell.	Lots of dendrites; Long axon
9	How are photosynthetic cells adapted for photosynthesis?	Lots of chloroplasts with chlorophyll to absorb light
10	What control the size of the stomata?	Guard cells
11	Define 'diffusion'.	Net movement of particles from an area of high to low concentration
12	Explain why a higher temperature results in faster diffusion.	More kinetic energy, particles move around more
13	Briefly describe the first stage in the cell cycle.	Cell size increase, DNA and organelle replication
14	Define 'differentiation'.	The process where a cell becomes specialised/adapted to perform specific functions
15	Where does differentiation of stem cells occur in humans?	Bone marrow
16	Why is the ability to clone plants quickly a benefit?	Produce large numbers of rare plants reliably and to safely stop their extinction
17	State one risk or concern people may have about using stem cells.	Unethical to use aborted embryos, difficult and expensive project
18	Chromosomes are arranged in ___ pairs in a human body cell.	23
19	What is a gene?	A short section of DNA that codes for a protein/controls a characteristic
20	Name the 2 gases that are exchanged in the alveoli.	Oxygen and carbon dioxide
21	How are alveoli adapted for efficient gaseous exchange?	Large SA, thin membrane and rich blood supply
22	How is the small intestine adapted so that it has a large surface area?	Villi, microvilli
23	How are plant roots adapted for efficient water and mineral absorption?	Large SA (root hairs), transpiration stream
24	State one organism that is prokaryotic.	Bacteria
25	What is the magnification equation?	Magnification = Image ÷ Object
26	Which gives a higher resolution - a light microscope or an electron microscope?	Electron

27	Which objective lens should we start using?	Low power objective lens x4
28	State a key difference between prokaryotes and eukaryotes.	Prokaryotes do not have a nucleus. Eukaryotes do.
29	What are partially permeable membranes?	Membranes that only allow some types of substances to pass through
30	How does active transport differ from diffusion and osmosis?	AT uses energy, D and O do not
31	Define 'mitosis'.	Cell division that produces two genetically identical daughter cells

C1 Atomic Structure and The Periodic Table

	Question	Answer
1	What is all matter made from?	Atoms
2	Different types of atoms are called?	Elements
3	Na represents an atom of?	Sodium
4	Where are all known elements shown?	In the periodic table.
5	What is a compound?	Two or more elements that have been chemically combined.
6	What is the chemical formula for the compound water?	H_2O
7	How many hydrogen atoms are there in the compound water?	2
8	How are compounds separated into elements?	In a chemical reaction
9	What are word equations used to represent?	Chemical reactions.
10	What is a mixture?	Two or more elements/compounds that are not chemically combined.
11	How would you separate a salt from a salt water solution?	Evaporation/Crystallisation
12	How would you separate two liquids with different BP?	Distillation
13	How would you separate a mixture of sand and water?	Filtration
14	What does insoluble mean?	Doesn't dissolve
15	How is the plum pudding model of an atom described?	A ball of positive charge with negative electrons embedded in it.
16	Which experiment disproved the plum pudding model?	The alpha particle scattering experiment
17	What did the alpha particle scattering experiment prove the existance of?	The nucleus
18	Who adapted the nuclear model to suggest that electrons orbit the nucleus at specific distances?	Neils Bohr
19	What sub-atomic particle did the experimental work of James Chadwick provide evidence for?	Neutrons
20	Name the 3 sub-atomic particles	proton, neutron, electron
21	Which sub-atomic particles are found in the nucleus?	proton and neutron
22	Which sub-atomic particle is found in orbitals around the nucleus?	electrons
23	What is the charge of a proton?	(positive) 1
24	what is the charge of a neutron?	0
25	What is the charge of an electron?	(negative) 1
26	Why do atoms have no overall charge?	They have the same number of protons and electrons
27	What does the atomic number tell us?	The number of protons (this is also the number of electrons)
28	What does the atomic mass tell us?	number of protons + number of neutrons
29	What is the relative mass of a proton?	1
30	What is the relative mass of a neutron?	1
31	What is the relative mass of an electron?	0 (very small)
32	What is the radius of an atom?	0.1nm

33	How much smaller is the nucleus compared to the atom?	1/10000
34	What is an isotope?	Atoms of the same element that have a different number of neutrons
35	What is an Ion?	An atom that has lost or gained electrons.
36	How many electrons can be held in the first (inner) orbital?	2
37	How many electrons can be held in the second orbital?	8
38	What is the electronic configuration for sodium?	2,8,1
39	How are elements in the periodic table arranged?	In order of atomic number
40	What does a group number tell us about an element?	How many electrons are in the outer shell.
41	What do elements in the same group have in common?	Similar properties.
42	Magnesium is in group 2, how many electrons does it have in its outer shell?	2
43	Before the discovery of the sub-atomic particles, how were the elements ordered?	Atomic Weight
44	How did Mendeleev overcome some of the issues with the early periodic tables?	He left gaps for undiscovered elements.
45	Are there more metal elements or non-metal elements?	Metal
46	What name is given to elements in group 0?	Nobel Gases
47	Why are group 0 elements unreactive?	They have a stable arrangement of electrons (full outer shell)
48	What is the trend in boiling points as you move down the group?	Boiling point increases as you move down the group.
49	What are group 1 elements known as?	Alkali Metals
50	write a word equation for group 1 metal reaction with oxygen	Metal + Oxygen --> Metal Oxide
51	Write a word equation for group 1 metal reaction with Water	Metal + Water --> Metal Hydroxide + Hydrogen
52	Write a word equation for group 1 metal reaction with chlorine	Metal + Chlorine --> Metal Chloride
53	How does the reactivity of the alkali metals change as you move down the group?	It increases
54	Why is potassium more reactive than lithium?	The negative electron in the outershell is further away from the positive charge of the nucleus because potassium has more energy levels, so there is less attraction and it is easier for the electron to be removed.
55	What group is known as The Halogens?	Group 7
56	What is the trend in boiling points as you move down group 7?	Boiling points increase as you move down the group
57	What is the trend in reactivity as you move down group 7?	Reactivity decreases.