THE DUSTON SCHOOL
Knowledge itself is power
TDS 4-19

Year 7 Science Knowledge Booklet

Term 5

Name:	**Class:**
Homework 1 Due: 22nd April	**Homework 3 Due: 20th May**
Homework 2 Due: 6th May	

Knowledge Booklet: **Acids and Alkali's**

Science Homework Task 1

Read all of this knowledge organiser.

Big Questions and Vocabulary

- What are acids?
- What are alkali's
- What is used to help with excess stomach acid?
- How are salts made? What rules link the naming of salts
- What are the trends in group 1
- What are the trends in group 7

Acids Acids are substances that neutralise bases/alkalis. They release at least one H^+ ion	**Alkali's** Alkali's are substances that neutralise acids. They are soluble bases, which release OH^- ions.	**Bases** Substance that neutralise acids
Displacement reactions A reaction where the more reactive element takes the place of a less reactive element in a compound	**Neutralisation** A reaction when an acid and a base/alkali react together to form a salt and water	**Soluble / Insoluble** If something is soluble, it dissolves in water. Once dissolved it is said to be **AQUEOUS** . Insoluble substances don't dissolve in water
pH scale A scale used to determine the acidity or alkalinity of a solution. 7 is neutral. Less than 7 is acidic, More than 7 is alkaline	**Concentration** The number of particles present in a certain volume. Typical units are g/dm^3 or mol/dm^3	**Strength of acid** How well it splits into its ions in water Strong acids completely ionise in water, weak acids partially ionise in water.
Concentrated Concentrated solutions have a large number of acid / alkali particles per unit of volume	**Dilute** Dilute solutions have a low number of acid / alkali particles per unit of volume	**Salt** Salts are compounds formed from the reaction between acids and bases. It is an ionic compound
Alkali metals Alkali metals are the group 1 metals. When they react with water they form alkaline solutions	**Halogens** Halogens are group 7 elements. When they react with metals they form salts.	**Diatomic** The molecule consists of two atoms. Halogens are diatomic, e.g Cl_2 Br_2.
Effervescence The term used for reactions that fizz when a gas is produced	**Filtration** Separation techniques used to remove solids from liquids / solutions	**Evaporation** Separation technique used to separate dissolved substances from solutions

Sample Extended Questions / Practical based questions

What is the difference between concentrated and dilute acids and alkalis

What is the pH scale and how does it link to neutralisation?

How can pure Copper sulfate crystals be obtained from Copper oxide and sulphuric acid

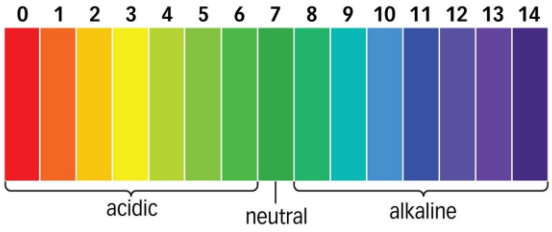
What are the trends in reactivity of group 1 metals with water.

What are displacement reactions, give examples using the halogens

Acids are substances that neutralise bases. They are solutions and when in solution they release H^+ ions. This is sometimes referred to as the acid particle

Not all acids react the same way, the strength of an acid depends on how much of it ionises in the solution.

Strong acids	***Completely ionised in aqueous solutions e.g. hydrochloric, nitric and sulfuric acids.***
Weak acids	***Only partially ionised in aqueous solutions e.g. ethanoic acid, citric acid.***
Hydrogen ion concentration	***As the pH decreases by one unit (becoming a stronger acid), the hydrogen ion concentration increases by a factor of 10.***



You can use universal indicator or a pH probe to measure the acidity or alkalinity of a solution against the pH scale.
In general terms, strong acid between 0-2 weak acids between 3 -6.
Neutral is pH 7 → This is when there are equal concentrations of H^+ and OH^- so it neither acidic nor alkaline
Weak alkalis are between 8-11 Strong alkali between 12-14

Acids and bases are used to produce salts in reactions called neutralisation reaction. The general word equations are:

Acid + alkali → Salt + water

Acid + base → Salt + water

Acid + carbonate → Salt + carbon dioxide + water

To name salts, you need a few simple rules.
The metal part of base never change its name.
The acid used form a particular salt, so the second part of salts name also depends on acid.

E.g

Sodium Hydroxide + Hydrochloric acid → Sodium chloride + water

Magnesium oxide + nitric acid → Magnesium nitrate + water

Acid name	Salt name
Hydrochloric acid	Chloride
Sulfuric acid	Sulfate
Nitric acid	Nitrate

Neutralisation	***Acids can be neutralised by alkalis and bases***	A **base** is a substance that neutralises an acid e.g. a soluble metal hydroxide or a metal oxide. An **alkali** is a soluble base e.g. metal hydroxide. In neutralisation, a salt and water are produced Once a substance has been **COMPLETELY** neutralized, the end pH will be 7

Production of soluble salts	***Salts are made in the reaction between acids and bases, if the salt needs to be extracted for use we need to make sure that it has completely reacted and remove all the water. To remember how to do this, remember WAFER.***

W	**W**arm the acid, this help increase rate of reaction
A	**A**dd the base to excess, this means add it until the solid base remains in the solution
F	**F**ilter the excess base using filter paper and funnel, collect the filtrate in a beaker
E	**E**vaporate the water, heat off about 50% of the water to concentrate the solution
R	**R**ate of cooling affects size of crystals, the quicker the water evaporates, the smaller the crystals, the slower the water evaporates, the bigger the crystals. Pat with filter paper to dry crystals.

1. React an acid with an excess of metal, metal oxide, hydroxide or carbonate until no more reacts.

2. Filter the mixture to get a solution of the salt with the excess solid left behind

3. Heat the solution to start evaporating the water from the solution.

4. Turn of the heat and leave until all of the water has evaporated, leaving the solid salt

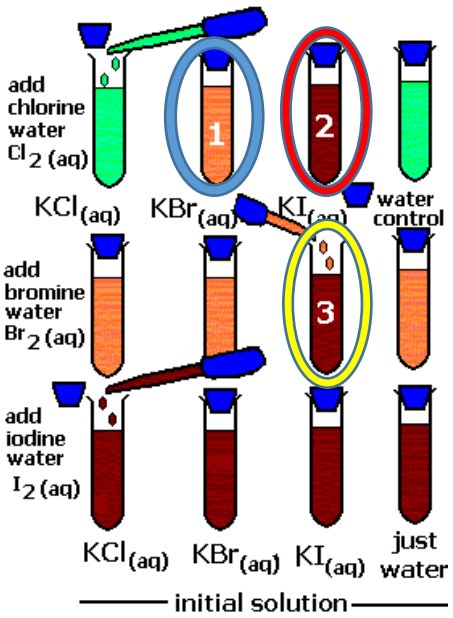
Group 1 in the periodic table is the alkali metals. These are not typical metals because they have some unusual properties. They are very soft → they can be easily cut with a knife. They are also not very dense (low mass per unit of volume) This means it can float on water.
They are also incredibly reactive, again not typical for the majority of metals.

Group 7 in the periodic table is the halogens. These are non metals that exist diatomically, e.g F_2 Cl_2 Br_2 and I_2 . Fluorine and Chlorine are gases, Bromine is a liquid whilst iodine is a solid. This is because the boiling point of halogens increases down the group
They have the opposite trend in reactivity compared to group 1, they get less reactive down the group / more reactive up the group.

	Common name	Physical Properties	Chemical Properties	Key Equations	Trends
Group 1	Alkali Metals	Soft, low density	React vigorously with water forming alkaline solutions and Hydrogen gas	$2M + 2H_2O \rightarrow 2MOH + H_2$	More reactive DOWN the group. They have one outer electron that they want to lose in order to get full outer shell. Down the group this outer shell is further from the nucleus so there is a weaker attraction to outer electron so it is more easily lost
Group 7	Halogens	Low melting point, Diatomic (X_2)	Take part in displacement reactions.	$2NaBr + Cl_2 \rightarrow 2NaCl + Br_2$	More reactive UP the group. They have 7 outer electrons and want to gain 1 electron to get a full outer shell. The closer the outer shell is to the nucleus, the stronger the force of attraction to the electron so the more reactive it is.

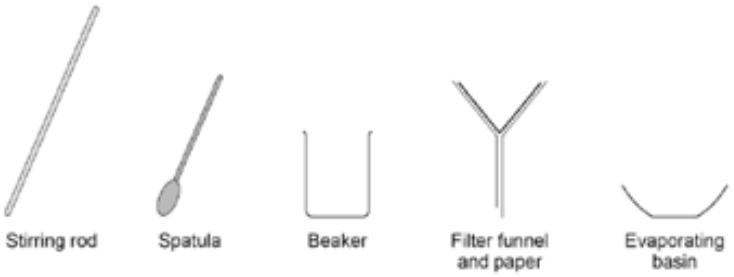
The halogens take part in displacement reactions, where the more reactive halogen takes the place of a less reactive halogen in a compound.
E.g $Cl_2 + 2KI \rightarrow 2KCl + I_2$
Chlorine is more reactive than iodine, and is reactive enough to force the Iodide ions to reform Iodine.
These reaction are often accompanied by colour changes depending on which halogen is formed
Cl_2 (aq) = Very pale green Br_2 (aq) = orange I_2 (aq) = brown

salt (aq) / halogen	potassium chloride	potassium bromide	potassium iodide
chlorine	X	$2KCl + Br_2$	$2KCl + I_2$
bromine	no reaction	X	$2KBr + I_2$
iodine	no reaction	no reaction	X



Q1. This question is about making copper salts.

The figure below shows the apparatus given to a student.



How could you safely warm the sulphuric acid?

Which must be added in excess?

What would you use to remove the excess

How could you concentrate the remaining solution

Outline a safe plan the student could use to make pure, dry, crystals of the soluble salt copper sulfate from the insoluble metal oxide and dilute acid.

(Total 6 marks)

(f) Describe how an indicator can be used to show when all the sodium hydroxide has reacted with sulfuric acid.

What is the name of suitable indicator

What colour would the indicator be in sulphuric acid (a strong acid)

What could would the indicator colour be when the acid has been neutralised (solution is neutral due to formation of salt and water

Science Homework 2

Literacy –

Learn these spellings

Neutralisation

Indicator

Concentrated

Dilute

Corrosive

Memory –

Learn to make crystals

Video - 10 minutes

Watch these videos

Neutralisation and pH:

www.youtube.com/watch?v=6OkZZcbdtkU

Making salts (up to 3:05)
www.youtube.com/watch?v=lpM_VCMPFug

Exam Practice (turn over)

BUG the question (draw a **Box** around the instruction word, **Underline** scientific key words, **Go** for the right number of marks)

Complete the exam questions on the back of this page.

Research

What is the difference between strong and weak acids? Find 5 examples of strong acids and 5 examples of weak acids.

Question

What does the pH scale actually measure?

What is the actual difference between a pH of 2 and 3?

Skills you are working on

Learning spellings using look, cover, write, check.
Making notes from the video.
Using memory techniques to learn the definitions.
Understand what the exam questions are asking.
Using key words in your answers.

Q1. The pH scale is a measure of the acidity or alkalinity of a solution.

(a) Draw one line from each solution to the pH value of the solution.

Solution	pH value of the solution
	5
Acid	7
	9
Neutral	11
	13

(2)

(b) Which ion in aqueous solution causes acidity?

H^+	☐	O^{2-}	☐
Na^+	☐	OH^-	☐

(1)

(c) When sulfuric acid is added to sodium hydroxide a reaction occurs to produce two products.

The equation is: $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

How many elements are in the formula H_2SO_4?

3	☐	6	☐
4	☐	7	☐

(d) What is this type of reaction?

Decomposition	☐
Displacement	☐
Neutralisation	☐
Reduction	☐

(1)

(e) Name the salt produced.

_____

(1)

(f) Describe how an indicator can be used to show when all the sodium hydroxide has reacted with sulfuric acid.

_____

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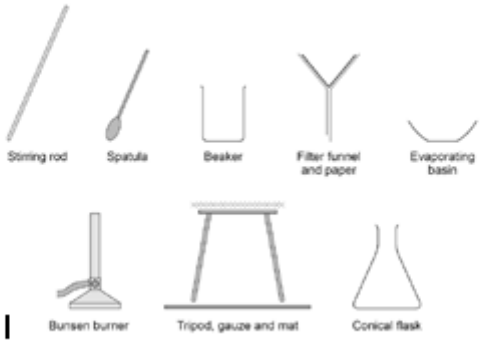
(3)

Q2. This question is about making copper salts. The figure below shows the apparatus given to a student.



Outline a safe plan the student could use to make pure, dry, crystals of the soluble salt copper sulfate from the insoluble metal oxide and dilute acid.

_____

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(Total 6 marks)

Knowledge Booklet: **Chemical reactions**

Big Questions and Vocabulary

- Why do atoms react?
- How do chemistry represent these reactions between elements, atoms and compounds.
- Why some elements change their name in compounds
- What rules explain how chemicals react
- What everyday reactions are responsible for modern day living
- What is crude oil and why is it so valuable.

Chemical Reactions When atoms are rearranged to form a new product	**Reactants** The starting chemicals in a reaction	**Products** The new chemicals made after a chemical reaction
Chemical formulae Shows the elements present in a molecule in the exact proportions, e.g CO_2 means 1 carbon atom 2 oxygen atoms bonded together	**Conservation of mass** Where the total mass of the reactants is equal to the total mass of products. Atoms cannot be gained or lost in a reaction	**Exothermic** A reaction where energy is released to the surroundings, they get warmer
Endothermic A reaction where energy is taken in from the surroundings, they get colder	**Combustion** An exothermic chemical reaction where an element or compound is reacted with oxygen forming new compounds	**Incomplete combustion** When there is a limited oxygen supply, so only partial oxidation is achieved, e.g when carbon monoxide forms
Hydrocarbon A compound containing only carbon and hydrogen atoms	**Crude oil** A mixture of hydrocarbons, it as a very viscous black liquid.	**Decomposition** A chemical reaction where one substance is broken down into two or more substances.

Knowledge Booklet: ***Chemical changes and Energy changes***

Sample Extended Questions / Practical based questions

What are the similarities and differences between chemical and physical reactions?

What rules are there for writing chemical formula's

When writing chemical equations, why must the equation be balanced?

Compare endothermic and exothermic reactions.

How are hydrocarbons extracted, what physical process is responsible for this?

Chemical reactions involve a rearrangement of the atoms in one substance to form new substances. It involves bond breaking and bond making and there is an overall energy change

Physical reaction do not involve a rearrangement of the atoms, but involve a change in state.

Word equations	***Uses words to show reaction*** **reactants → products** **magnesium + oxygen → magnesium oxide**	Does not show what is happening to the arrangement of atoms or the number of atoms.
Chemical equations	***Uses symbols to show reaction*** **reactants → products** **$2Mg + O_2 \rightarrow 2MgO$**	Shows the number of atoms and molecules in the reaction, these need to be balanced.

Chemical equations must be balanced due to the law of conservation of mass.

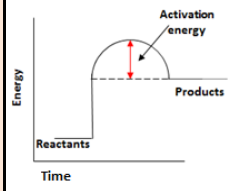
No atoms can be created or destroyed in chemical reactions, but they are rearranged. The number of and type of atoms you have at the start is equal to the number and type of atoms of the products

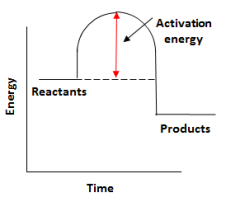
Start of equations	***$Mg + O_2 \rightarrow MgO$***	Count the number of atoms of Mg each side, 1 on left one or right so currently balanced. However 2 oxygens on left only 1 on right
Add second MgO to R.H.S (cant add random atoms)	***$Mg + O_2 \rightarrow MgO$*** *MgO*	Now have 2 atoms of oxygen both side, but you have added a second Mg to the right, with still 1 of left
Add second Mg to L.H.S	***$Mg + O_2 \rightarrow MgO$*** ***Mg MgO***	Double check all atoms, 2 Mg on left and right, 2 O on left and right
Total number of each molecule and add number IN FRONT	***$2Mg + O_2 \rightarrow 2\ MgO$*** ***Mg MgO***	The number in front shows the number of that molecule you have

When naming compound, some elements change their name when they are in a compound

Oxygen	***Changes its name to oxide when bonded to a metal.*** ***If bonded to another non metal, it change its name to monoxide or dioxide depending on whether there is 1 or 2 oxygens in the compound***	MgO → Sodium oxide Al_2O_3 → Aluminium oxide CO → Carbon monoxide CO_2 → Carbon dioxide
Halogens (Fluorine Chlorine Bromine, Iodine)	***Each of the names change the end of their names from ine → ide when bonded to metals*** ***Fluorine → Fluoride*** ***Chlorine → Chloride*** ***Bromine → bromide*** ***Iodine → Iodide***	NaF → Sodium Fluoride KCl → Potassium Chloride $MgBr_2$ → Magnesium Bromide FeI_3 → Iron iodide

When chemical reactions take place, energy is taken in by the molecules to break bonds, but also released when new bonds are made. It is the balance between the two that determines if a reaction increases the temperature of the surroundings or decreases the energy of the surroundings

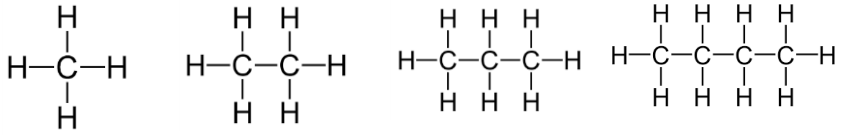
Endothermic		**Products are at a higher energy level than the reactants. As the reactants form products, energy is transferred from the surroundings to the reaction mixture. The temperature of the surroundings decreases because energy is taken in during the reaction.**

Exothermic		**Products are at a lower energy level than the reactants. As the reactants form products, energy is transferred to the surroundings from the reaction mixture. The temperature of the surroundings increases because energy is released during the reaction.**

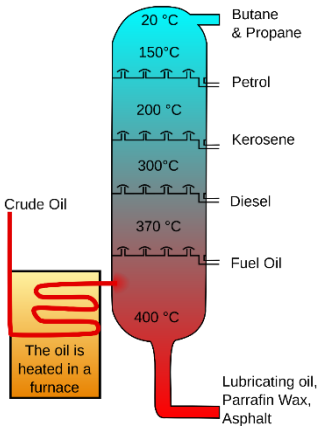
Endothermic	**Energy is taken in from the surroundings making the surrounding colder. This is because more energy is needed to break bonds than gets released making bonds**	• **Thermal decomposition** • **Sports injury packs**
Exothermic	**Energy is released to the surroundings making the surrounding warmer. This is because more energy is released making bonds than is needed to break bonds.**	• **Combustion** • **Hand warmers** • **Neutralisation**

Crude oil is a non renewable resource, that contains a variety of compounds, including hydrocarbons, (compounds that only contain atoms of carbon and hydrogen.

Alkanes are saturated hydrocarbons (only have single bonds between carbon atoms) they all have the general formula C_nH_{2n+2} When drawing, each Carbon has 4 bonds coming from it.



Methane (CH_4) Ethane (C_2H_6) Propane (C_3H_8) Butane (C_4H_{10})



Hydrocarbon chains	***In oil***	Hydrocarbon chains in crude oil come in lots of different lengths, they are held together by lots of intermolecular forces, which is why crude oil is a very viscous liquid
	Boiling points	The boiling point (the temperature when we get a change of state from liquid to gas or gas to liquid) of the chain depends on its length. The longer the chain, the higher the boiling point as there are more forces between the different molecules (intermolecular forces) These require more energy to break.

Boiling point (temperature at which liquid boils)	***As the hydrocarbon chain length increases, boiling point increases. This is because more energy in needed to break the intermolecular forces***
Viscosity (how easily it flows)	***As the hydrocarbon chain length increases, viscosity increases, this is because there are more intermolecular forces holding the chains / molecules together***
Flammability (how easily it combusts / oxidises)	***As the hydrocarbon chain length increases, flammability decreases, this is because the small chains have lower molecular masses, which makes it easier for oxygen to react with them at lower temperatures.***

Decomposition	***Decomposition reactions occur when a substance is broken down into 2 or more new substances. This is often done by applying heat (thermal decomposition) or adding a chemical that lowers the energy required to break bonds (catalyst)***
Examples	***Longer chain hydrocarbons aren't as in demand as smaller chain hydrocarbons, so these are often cracked (undergo decomposition) to get more useful products form them.***

Complete combustion	***When there is plenty / excess on oxygen, and the carbon and hydrogen form new bonds with oxygen in the air to form Carbon dioxide and water.***
Incomplete combustion	***When there is limited oxygen, and the carbon doesn't completely react with the oxygen. Water is always produced. Either carbon monoxide or Carbon particulates are produced. Carbon monoxide is a very toxic gas that can kill you.***

Have a go at balancing these equations. Use the method from earlier, remember overall you cannot change the chemical formula of the chemicals, you can only change the number of the molecules you have.

1	H_2	+	Cl_2	→	HCl					
2	Zn	+	O_2	→	ZnO					
3	Cl_2	+	Al	→	$AlCl_3$					
4	Na	+	O_2	→	Na_2O					
5	Mg	+	O_2	→	MgO					
6	Mg	+	HCl	→	$MgCl_2$	+	H_2			
7	Fe_2O_3	+	Al	→	Fe	+	Al_2O_3			
8	$CaCl_2$	+	KOH	→	$Ca(OH)_2$	+	KCl			
9	HCl	+	Na_2CO_3	→	NaCl	+	H_2O	+	CO_2	
10	HNO_3	+	NaOH	→	$NaNO_3$	+	H_2O			

This question is about energy changes in chemical reactions.

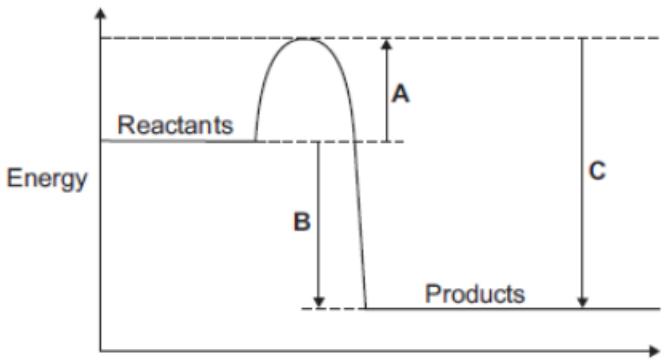
(a) Complete the word equation for the combustion of hydrogen.

hydrogen + oxygen → _____

(1)

(b) **Figure 1** shows a simple energy level diagram.

Figure 1



(i) Which arrow, **A**, **B** or **C**, shows the activation energy?

Tick (✓) **one** box.

A ☐

B ☐

C ☐

(1)

(ii) What type of reaction is shown by the energy level diagram in **Figure 1**?

(ii) The table shows five of these compounds.

Compound	State at room temperature (20 °C)	Boiling point in °C
ethane, C_2H_6	gas	– 89
butane, C_4H_{10}	gas	0
hexane, C_6H_{14}	liquid	+69
pentadecane, $C_{15}H_{32}$	liquid	+270
heptadecane, $C_{17}H_{36}$	solid	+302

(2)

Tick (✓) **two** correct statements about the five compounds.

Statement	Tick (✓)
ethane has the smallest molecules	
hexane and pentadecane are liquid at 100 °C	
heptadecane has the highest boiling point	
butane boils at 100 °C	

(2)

(iii) Draw a ring around the correct answer to complete each sentence.

Fractional distillation is used to separate the compounds in crude oil.

The first step in fractional distillation is [cracking / displacing / evaporating] the crude oil.

During fractional distillation the compounds [burn / condense / decompose] at different temperatures.

(2)

Useful Websites

Science Homework Task 3

Read all of this knowledge organiser and revise ready for the end of term Pillars test, there will be questions on acids and alkalis, chemical reactions and forces at a distance. Make sure you can answer these questions.

Question	Answer
What do we call a chemical reaction where energy is given out?	
Name 3 things we might see if a chemical reaction is happening.	
What word describes a reaction where something is broken down into 2 or more products?	
Complete this equation for the complete combustion of carbon - carbon + oxygen →	
What do we call a reaction that takes in energy?	
What ion is released by acids?	
What type of salt is formed when hydrochloric acid reacts with a metal?	
What is the name given to elements in group 1?	
What two products are formed when an acid and alkali react?	
What type of salt is formed when sulfuric acid reacts with a metal?	
We use a word to remind us the steps in making soluble salts, what is it?	
What is the unit of weight?	
If you travelled to the moon which would change, your mass or your weight?	
What is mass?	
What equation links gravitational field strength, mass and weight?	
What do we call an unbalanced charge caused by friction?	
A magnet can attract another magnet, what else can it attract?	