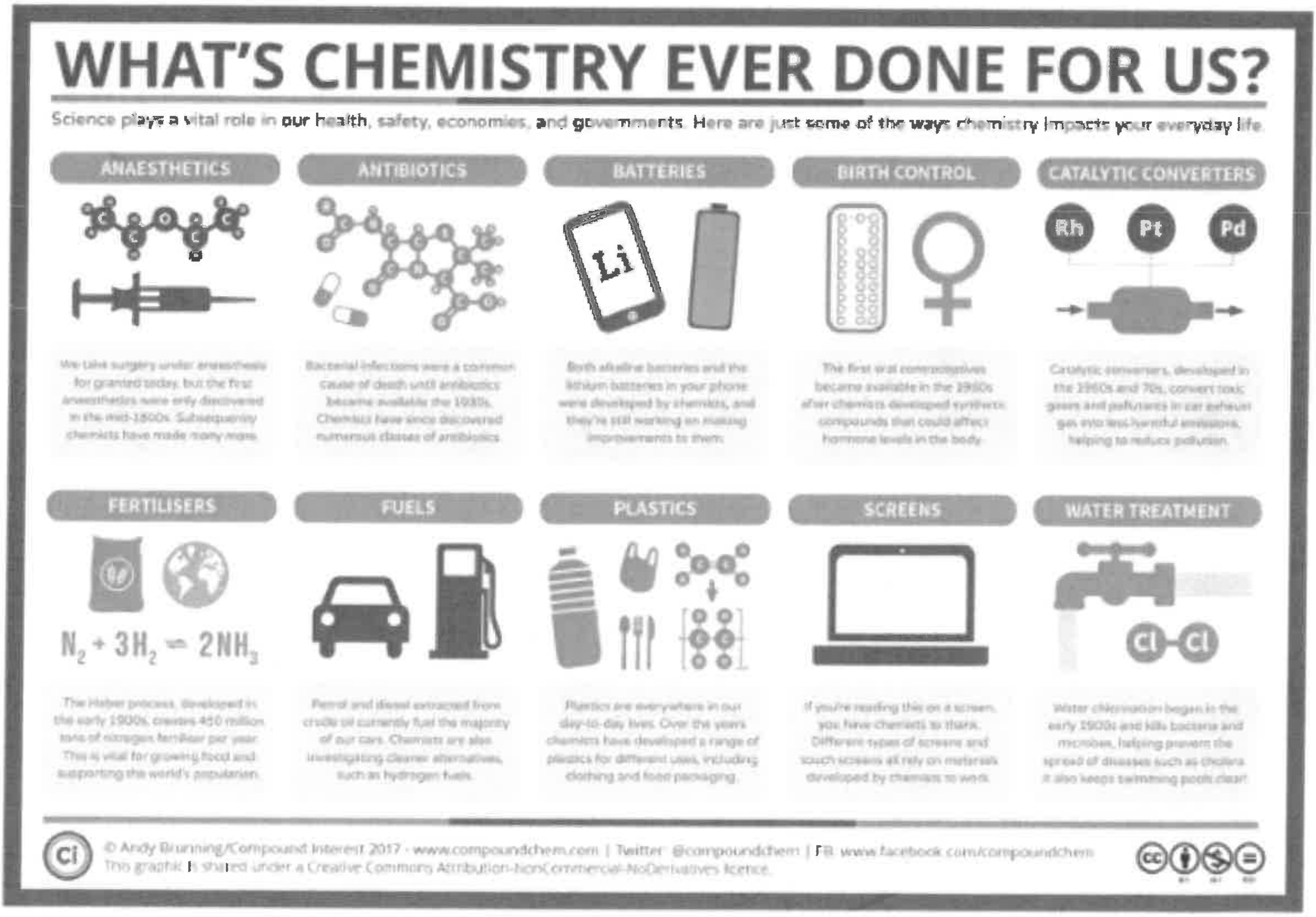
Name ______________

Chemistry Summer Work



WHAT'S CHEMISTRY EVER DONE FOR US?

Science plays a vital role in our health, safety, economies, and governments. Here are just some of the ways chemistry impacts your everyday life.

ANAESTHETICS

ANTIBIOTICS

BATTERIES

BIRTH CONTROL

CATALYTIC CONVERTERS

FERTILISERS

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

FUELS

PLASTICS

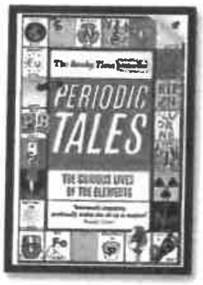
SCREENS

WATER TREATMENT

Bring this to your first Chemistry Lesson in September.

Book Recommendations

Periodic Tales: The Curious Lives of the Elements (Paperback) Hugh Aldersey-Williams



ISBN-10: 0141041455

This book covers the chemical elements, where they come from and how they are used. There are loads of fascinating insights into uses for chemicals you would have never even thought about.

The Science of Everyday Life: Why Teapots Dribble, Toast Burns and Light Bulbs Shine (Hardback) Marty Jopson

ISBN-10: 1782434186

The title says it all really, lots of interesting stuff about the things around you home!

Bad Science (Paperback) Ben Goldacre

ISBN-10: 000728487X

Here Ben Goldacre takes apart anyone who published bad / misleading or dodgy science – this book will make you think about everything the advertising industry tries to sell you by making it sound 'sciency'.

Calculations in AS/A Level Chemistry (Paperback) Jim Clark

ISBN-10: 0582411270

If you struggle with the calculations side of chemistry, this is the book for you. Covers all the possible calculations you are ever likely to come across. Brought to you by the same guy who wrote the excellent chemguide.co.uk website.

Key Experiments

Task 1: One of the joys of science at key stage five is the increase in the quantity and significance of practical work. Having a strong set of practical skills is essential to all scientists irrelevant of how much practical work they do on a day-to-day basis. Fill in the table below to give the details of what are some of the most important scientific investigations of the last 150 years.

Year of investigation	Scientists involved	Description of experiment and details of discovery
1898	Marie and Pierre Curie	
1911	Ernest Rutherford	
1928	Alexander Fleming	
1944	Russell Marker	

Science in the News

Task 2: Read the following articles and answer the questions about each one.

Genes that make lemons sour revealed

BY NINA NOTMAN | 5 MARCH 2019

Dutch scientists have unravelled the mystery of why some citrus fruits are eye-wateringly sour and others are scrumptiously sweet.[1] The discovery that a mutation in two proton pumping proteins can produce sweeter fruit may allow farmers to tune their harvest to customers' tastes.

The researchers, led by Ronald Koes and Francesca Quattrocchio at the University of Amsterdam, became interest in this area during an effort to identify the genes responsible for the colour of petunia flowers. They looked for differences in two variants of this flowering plant – the standard one with red–purple petals and a blue mutant. 'The measurements of the crude extract of the petals showed that the blue flowers are less acidified than the reddish ones,' says Quattrocchio.

The team realised that the mutation affected the acidification system in cell compartments called vacuoles, where colour pigments are also stored. 'These pigments behave like pH indicators,' Quattrocchio explains. 'If there is a change in pH in the lumen of the vacuoles, you see this translated in a change of colour.'

In plant cells, vacuoles are normally more acidic than the surrounding cytoplasm. This gradient is controlled by protein pumps that transport protons across the membrane into the vacuoles. In the red–purple flowers, the pH difference between vacuole and cytoplasm is unusually large.

In 2014, the team revealed the two interacting protein pumps responsible for hyperacidification in petunia petals.[2] The blue colour of petunia mutants is due to a mutation in the genes encoding for those proteins and this results in a less acid vacuole which the pigments respond to.

Emily Liman, an expert in taste perception at the University of Southern California, US, describes the work as 'fascinating'. 'These investigators found the causative mutation that lowers the level of expression of the proton pump in the less sour varieties of lemons,' she explains.

The researchers identified the same mutation in other citrus fruit including oranges and limes, and predict that the same pumps control acidity in non-citrus fruits such as grapes and strawberries. 'Breeders could use this knowledge, in principle, in two ways,' says Koes, to make genetically modified fruits or for molecular breeding.

In classical plant breeding, species are interbred to produce fruits with desirable properties. This process is slow, as breeders must wait for plants to become established enough to produce fruit for tasting.

'If you know which DNA sequences to look for, it's really easy to isolate a bit of DNA from a plant just a few weeks after germination and tell which of those acid genes that you want to have are in there,' Koes says. 'One could determine the potential acid content, and the expected taste of a fruit, using simple molecular methods such as polymerase chain reaction,' adds Liman. This means thousands of different new variants could be rapidly screened to allow farmers to tune their next harvest to hit consumers' sweet spot.

This got the team wondering whether proton pumps play a role in extremely acidic citrus plants. How juice-containing vacuoles in citrus fruits are hyperacidified was a long-standing unanswered question. 'We studied the differences between the sweet and sour lemons just like we did with the acidic red and less acidic blue petunia, and we found out that the pumps involved were the same,' Quattrocchio says.

Juice vesicles of lemon varieties with very sour fruits express two genes encoding for two proton-pumping proteins. Expression levels are much lower in varieties with sweeter fruit.

1. **Give the pH of a weak acid**

2. **Explain why a hydrogen ion can be described as a proton.**

3. **What would happen to the pH of a vacuole as more hydrogen ions are pumped into it?**

The plastic that came out of thin air!

Re-enactment of the 1938 discovery of Teflon®
Left to right, Jack Rebok, Robert McHarness and Roy Plunkett

Read the cartoon and then answer the following questions.

1. What was the date?
2. What project was Roy Plunkett working on?
3. Name and give the formula of the gas he was going to use.
4. Why was Plunkett surprised when no gas came out of the cylinder?
5. What did he think the problem was?
6. What did he do next and what risk was involved?
7. Which process are used in the manufacture of plastics?
8. Suggest three tests Roy Plunkett may have carried out on the new material in order to test its properties.

Roy Plunkett accidentally discovers Teflon

6/4/1938

Refrigerants Work

Jobs to do:

1. *Get a new cylinder of tetrafluoroethene gas.*
2. *Clean out equipment.*

6/4/1938

Conclusions about the cylinder.

The small gaseous particles must have reacted together to make this solid.

There wasn't anything else there.

7/4/1938

1. *Try to reproduce the white solid in the lab.*

Task 3: Follow the instructions on the following pages and answer questions for each activity.

Relative atomic mass (A_r)

If there are several isotopes of an element, the relative atomic mass will take into account the proportion of atoms in a sample of each isotope.

For example, chlorine gas is made up of 75% of chlorine-35 ${}^{35}_{17}Cl$ and 25% of chlorine-37 ${}^{37}_{17}Cl$.

The relative atomic mass of chlorine is therefore the mean atomic mass of the atoms in a sample, and is calculated by:

$$A_r = \left(\frac{75.0}{100} \times 35\right) + \left(\frac{25.0}{100} \times 37\right) = 26.25 + 9.25 = 35.5$$

Activity 9

1. What is the relative atomic mass of Bromine, if the two isotopes, ${}^{79}Br$ and ${}^{81}Br$, exist in equal amounts?

2. Neon has three isotopes. ${}^{20}Ne$ accounts for 90.9%, ${}^{21}Ne$ accounts for 0.3% and the last 8.8% of a sample is ${}^{22}Ne$. What is the relative atomic mass of neon?

3. Magnesium has the following isotope abundances: ${}^{24}Mg$: 79.0%; ${}^{25}Mg$: 10.0% and ${}^{26}Mg$: 11.0%. What is the relative atomic mass of magnesium?

Harder:

4. Boron has two isotopes, ${}^{10}B$ and ${}^{11}B$. The relative atomic mass of boron is 10.8. What are the percentage abundances of the two isotopes?

5. Copper's isotopes are ${}^{63}Cu$ and ${}^{65}Cu$. If the relative atomic mass of copper is 63.5, what are the relative abundances of these isotopes?

Common ions

Positive ions (cations)		Negative ions (anions)	
Name	Symbol	Name	Symbol
Hydrogen	H^+	Hydroxide	OH^-
Sodium	Na^+	Chloride	Cl^-
Lithium	Li^+	Bromide	Br^-
Silver	Ag^+	Oxide	O^{2-}
Magnesium	Mg^{2+}	Hydrogencarbonate	HCO_3^-
Calcium	Ca^{2+}	Nitrate	NO_3^-
Zinc	Zn^{2+}	Sulfate	SO_4^{2-}
Aluminium	Al^{3+}	Carbonate	CO_3^{2-}
Ammonium	NH_4^+	Phosphate	PO_4^{3-}

Some elements have more than one charge. For example, iron can form ions with a charge of +2 or +3. Compounds containing these are named Iron(II) and Iron(III) respectively.

Other common elements with more than one charge include:

Chromium(II) and chromium(III)

Copper(I) and copper(II)

Lead(II) and lead(IV)

Activity 11

On the periodic table on the following page, colour elements that form one atom ions (eg Na^+ or O^{2-}) according to the following key:

Charge	Colour
+1	red
+2	yellow
+3	green
-1	blue
-2	brown

Key

relative atomic mass
symbol
name
atomic (proton) number

1	2											3	4	5	6	7	0
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*	*(16)*	*(17)*	*(18)*
							1.0 **H** hydrogen 1										4.0 **He** helium 2
6.9 **Li** lithium 3	9.0 **Be** beryllium 4											10.8 **B** boron 5	12.0 **C** carbon 6	14.0 **N** nitrogen 7	16.0 **O** oxygen 8	19.0 **F** fluorine 9	20.2 **Ne** neon 10
23.0 **Na** sodium 11	24.3 **Mg** magnesium 12											27.0 **Al** aluminium 13	28.1 **Si** silicon 14	31.0 **P** phosphorus 15	32.1 **S** sulfur 16	35.5 **Cl** chlorine 17	39.9 **Ar** argon 18
39.1 **K** potassium 19	40.1 **Ca** calcium 20	45.0 **Sc** scandium 21	47.9 **Ti** titanium 22	50.9 **V** vanadium 23	52.0 **Cr** chromium 24	54.9 **Mn** manganese 25	55.8 **Fe** iron 26	58.9 **Co** cobalt 27	58.7 **Ni** nickel 28	63.5 **Cu** copper 29	65.4 **Zn** zinc 30	69.7 **Ga** gallium 31	72.6 **Ge** germanium 32	74.9 **As** arsenic 33	79.0 **Se** selenium 34	79.9 **Br** bromine 35	83.8 **Kr** krypton 36
85.5 **Rb** rubidium 37	87.6 **Sr** strontium 38	88.9 **Y** yttrium 39	91.2 **Zr** zirconium 40	92.9 **Nb** niobium 41	96.0 **Mo** molybdenum 42	[98] **Tc** technetium 43	101.1 **Ru** ruthenium 44	102.9 **Rh** rhodium 45	106.4 **Pd** palladium 46	107.9 **Ag** silver 47	112.4 **Cd** cadmium 48	114.8 **In** indium 49	118.7 **Sn** tin 50	121.8 **Sb** antimony 51	127.6 **Te** tellurium 52	126.9 **I** iodine 53	131.3 **Xe** xenon 54
132.9 **Cs** caesium 55	137.3 **Ba** barium 56	138.9 **La *** lanthanum 57	178.5 **Hf** hafnium 72	180.9 **Ta** tantalum 73	183.8 **W** tungsten 74	186.2 **Re** rhenium 75	190.2 **Os** osmium 76	192.2 **Ir** iridium 77	195.1 **Pt** platinum 78	197.0 **Au** gold 79	200.6 **Hg** mercury 80	204.4 **Tl** thallium 81	207.2 **Pb** lead 82	209.0 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac †** actinium 89	[267] **Rf** rutherfordium 104	[268] **Db** dubnium 105	[271] **Sg** seaborgium 106	[272] **Bh** bohrium 107	[270] **Hs** hassium 108	[276] **Mt** meitnerium 109	[281] **Ds** darmstadtium 110	[280] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

* 58 – 71 Lanthanides	140.1 **Ce** cerium 58	140.9 **Pr** praseodymium 59	144.2 **Nd** neodymium 60	[145] **Pm** promethium 61	150.4 **Sm** samarium 62	152.0 **Eu** europium 63	157.3 **Gd** gadolinium 64	158.9 **Tb** terbium 65	162.5 **Dy** dysprosium 66	164.9 **Ho** holmium 67	167.3 **Er** erbium 68	168.9 **Tm** thulium 69	173.1 **Yb** ytterbium 70	175.0 **Lu** lutetium 71
† 90 – 103 Actinides	232.0 **Th** thorium 90	231.0 **Pa** protactinium 91	238.0 **U** uranium 92	[237] **Np** neptunium 93	[244] **Pu** plutonium 94	[243] **Am** americium 95	[247] **Cm** curium 96	[247] **Bk** berkelium 97	[251] **Cf** californium 98	[252] **Es** einsteinium 99	[257] **Fm** fermium 100	[258] **Md** mendelevium 101	[259] **No** nobelium 102	[262] **Lr** lawrencium 103

Ionic compounds must have an overall neutral charge. The ratio of cations to anions must mean that there is as many positives as negatives.

For example:

NaCl	
Na^+	Cl^-
+1	-1

MgO	
Mg^{2+}	O^{2-}
+2	−2

$MgCl_2$	
Mg^{2+}	Cl^-
	Cl^-
+2	−2

Activity 12

Work out what the formulas for the following ionic compounds should be:

1. Magnesium bromide
2. Barium oxide
3. Zinc chloride
4. Ammonium chloride
5. Ammonium carbonate
6. Aluminium bromide
7. Iron(II) sulfate
8. Iron(III) sulfate

Activity 14

Write balanced symbol equations for the following reactions. You'll need to use the information on the previous pages to work out the formulas of the compounds. Remember some of the elements may be diatomic molecules.

1. Aluminium + oxygen → aluminium oxide

2. Methane + oxygen → carbon dioxide + water

3. Aluminium + bromine → aluminium bromide

4. Calcium carbonate + hydrochloric acid → calcium chloride + water + carbon dioxide

5. Aluminium sulfate + calcium hydroxide → aluminium hydroxide + calcium sulfate

   Harder:

6. Silver nitrate + potassium phosphate → silver phosphate + potassium nitrate

   More challenging:

7. Potassium manganate(VII) + hydrochloric acid →

   potassium chloride + manganese(II) chloride + water + chlorine