A-LEVEL CHEMISTRY TRANSITION WORK 2023

Complete the 15 Activities. Check your answers at the back of the pack as you go.

Activity 7 is a project, so no answers supplied

Please hand all work to your teacher at the start of term

CONTENT

1.SI units

Every measurement must have a size (eg 2.7) and a unit (eg metres or ºC). Sometimes there are different units available for the same type of measurement, for example ounces, pounds, kilograms, and tonnes are all used as units for mass. To reduce confusion and to help with conversion between different units, there is a standard system of units called the SI units which are used for most scientific purposes. These units have all been defined by experiment so that the size of, say, a metre in the UK is the same as a metre in China. The seven SI base units are

Physical quantity	Usual quantity symbol	Unit	Abbreviation
mass	m	kilogram	kg
length	l or x	metre	m
time	t	second	s
electric current	I	ampere	A
temperature	T	kelvin	K
amount of substance	n	mole	mol
luminous intensity	(not used at A-level)	candela	cd

All other units can be derived from the SI base units.

For example, area is measured in square metres (written as m^2) and speed is measured in metres per second (written as ms^{-1}).

It is not always appropriate to use a full unit. For example, measuring the width of a hair or the distance from Manchester to London in metres would cause the numbers to be difficult to work with.

Prefixes are used to multiply each of the units. You will be familiar with centi (meaning 1/100), kilo (1000) and milli (1/1000) from centimetres, kilometres and millimetres.

There is a wide range of prefixes. The majority of quantities in scientific contexts will be quoted using the prefixes that are multiples of 1000. For example, a distance of 33 000 m would be quoted as 33 km.

The most common prefixes you will encounter are:

Prefix	Symbol	Multiplication factor		
Tera	T	10_{12}	1 000 000 000 000	
Giga	G	10_{9}	1 000 000 000	
Mega	M	10_{6}	1 000 000	
kilo	k	10^{3}	1000	
deci	d	10_{-1}	0.1	1/10
centi	c	10_{-2}	0.01	1/100
milli	m	10_{-3}	0.001	1/1000
micro	μ	10_{-6}	0.000 001	1/1 000 000
nano	n	10_{-9}	0.000 000 001	1/1 000 000 000
pico	p	10_{-12}	0.000 000 000 001	1/1 000 000 000 000
femto	f	10_{-15}	0.000 000 000 000 001	1/1 000 000 000 000 000

Activity 1

Which SI unit and prefix would you use for the following quantities?

1. The mass of water in a test tube.

2. The time taken for a solution to change colour.

3. The radius of a gold atom.

4. The volume of water in a burette.

5. The amount of substance in a beaker of sugar.

6. The temperature of the blue flame from a Bunsen burner.

Sometimes, there are units that are used that are not combinations of SI units and prefixes. These are often multiples of units that are helpful to use. For example, one litre is 0.001 m^3 .

Activity 2

Rewrite the following in SI units.

1. 5 minutes

2. 2 days

3. 5.5 tonnes

Activity 3

Rewrite the following quantities.

1. 0.00122 metres in millimetres

2. 104 micrograms in grams

3. 1.1202 kilometres in metres

4. 70 decilitres in millilitres

5. 70 decilitres in litres

6. 10 cm^3 in litres

2. Important vocabulary for practical work

Activity 4

Join the boxes to link the word to its definition.

Accurate	A statement suggesting what may happen in the future.
Data	An experiment that gives the same results when a different person carries it out, or a different technique or set of equipment is used.
Precise	A measurement that is close to the true value.
Prediction	An experiment that gives the same results when the same experimenter uses the same method and equipment.
Range	Physical, chemical or biological quantities or characteristics.
Repeatable	A variable that is kept constant during an experiment.
Reproducible	A variable that is measured as the outcome of an experiment.
Resolution	This is the smallest change in the quantity being measured (input) of a measuring instrument that gives a perceptible change in the reading.
Uncertainty	The interval within the true value can be expected to lie.
Variable	The spread of data, showing the maximum and minimum values of the data.
Control variable	Measurements where repeated measurements show very little spread.
Dependent variable	Information, in any form, that has been collected.

3. Precise language

It is essential to use precise language when you write reports and when you answer examination questions. You must always demonstrate that you understand a topic by using the correct and appropriate terms.

For example, you should take care when discussing bonding to refer to the correct particles and interactions between them.

Also, when discussing the interaction between particles in an ionic solid, you would demonstrate a lack of understanding if you referred to the particles as atoms or molecules instead of ions or the interaction between these ions as intermolecular forces rather than electrostatic forces. In this case, use of the incorrect terms would result in the loss of all the marks available for that part of a question.

Take care also to use the word 'chloride' and not 'chlorine' when referring to the ions in a compound such as sodium chloride. The word 'chlorine' should only be used for atoms or molecules of the element.

4. The periodic table

The periodic table of elements is shown on the back page of this booklet. The A-level course will build on what you've learned in your GCSE studies.

Activity 5

On the periodic table on the following page:

- Draw a line showing the metals and non-metals.
- Colour the transition metals blue.
- Colour the halogens yellow.
- Colour the alkali metals red.
- Colour the noble gases green.
- Draw a blue arrow showing the direction of periods.
- Draw a red arrow showing the direction of groups.
- Draw a blue ring around the symbols for all gases.
- Draw a red ring around the symbols for all liquids.

The Periodic Table of the Elements

(1)	(2)											(3)	(4)	(5)	(6)	(7)	(0)
1												**13**	**14**	**15**	**16**	**17**	**18**
1 **H** hydrogen 1.0	**2**																2 **He** helium 4.0
3 **Li** lithium 6.9	4 **Be** beryllium 9.0											5 **B** boron 10.8	6 **C** carbon 12.0	7 **N** nitrogen 14.0	8 **O** oxygen 16.0	9 **F** fluorine 19.0	10 **Ne** neon 20.2
11 **Na** sodium 23.0	12 **Mg** magnesium 24.3	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	13 **Al** aluminium 27.0	14 **Si** silicon 28.1	15 **P** phosphorus 31.0	16 **S** sulfur 32.1	17 **Cl** chlorine 35.5	18 **Ar** argon 39.9
19 **K** potassium 39.1	20 **Ca** calcium 40.1	21 **Sc** scandium 45.0	22 **Ti** titanium 47.9	23 **V** vanadium 50.9	24 **Cr** chromium 52.0	25 **Mn** manganese 54.9	26 **Fe** iron 55.8	27 **Co** cobalt 58.9	28 **Ni** nickel 58.7	29 **Cu** copper 63.5	30 **Zn** zinc 65.4	31 **Ga** gallium 69.7	32 **Ge** germanium 72.6	33 **As** arsenic 74.9	34 **Se** selenium 79.0	35 **Br** bromine 79.9	36 **Kr** krypton 83.8
37 **Rb** rubidium 85.5	38 **Sr** strontium 87.6	39 **Y** yttrium 88.9	40 **Zr** zirconium 91.2	41 **Nb** niobium 92.9	42 **Mo** molybdenum 95.9	43 **Tc** technetium	44 **Ru** ruthenium 101.1	45 **Rh** rhodium 102.9	46 **Pd** palladium 106.4	47 **Ag** silver 107.9	48 **Cd** cadmium 112.4	49 **In** indium 114.8	50 **Sn** tin 118.7	51 **Sb** antimony 121.8	52 **Te** tellurium 127.6	53 **I** iodine 126.9	54 **Xe** xenon 131.3
55 **Cs** caesium 132.9	56 **Ba** barium 137.3	57–71 lanthanoids	72 **Hf** hafnium 178.5	73 **Ta** tantalum 180.9	74 **W** tungsten 183.8	75 **Re** rhenium 186.2	76 **Os** osmium 190.2	77 **Ir** iridium 192.2	78 **Pt** platinum 195.1	79 **Au** gold 197.0	80 **Hg** mercury 200.6	81 **Tl** thallium 204.4	82 **Pb** lead 207.2	83 **Bi** bismuth 209.0	84 **Po** polonium	85 **At** astatine	86 **Rn** radon
87 **Fr** francium	88 **Ra** radium	89–103 actinoids	104 **Rf** rutherfordium	105 **Db** dubnium	106 **Sg** seaborgium	107 **Bh** bohrium	108 **Hs** hassium	109 **Mt** meitnerium	110 **Ds** darmstadtium	111 **Rg** roentgenium	112 **Cn** copernicium		114 **Fl** flerovium		116 **Lv** livermorium		

Key
atomic number
Symbol
name
relative atomic mass

57 **La** lanthanum 138.9	58 **Ce** cerium 140.1	59 **Pr** praseodymium 140.9	60 **Nd** neodymium 144.2	61 **Pm** promethium 144.9	62 **Sm** samarium 150.4	63 **Eu** europium 152.0	64 **Gd** gadolinium 157.2	65 **Tb** terbium 158.9	66 **Dy** dysprosium 162.5	67 **Ho** holmium 164.9	68 **Er** erbium 167.3	69 **Tm** thulium 168.9	70 **Yb** ytterbium 173.0	71 **Lu** lutetium 175.0
89 **Ac** actinium	90 **Th** thorium 232.0	91 **Pa** protactinium	92 **U** uranium 238.1	93 **Np** neptunium	94 **Pu** plutonium	95 **Am** americium	96 **Cm** curium	97 **Bk** berkelium	98 **Cf** californium	99 **Es** einsteinium	100 **Fm** fermium	101 **Md** mendelevium	102 **No** nobelium	103 **Lr** lawrencium

Activity 6

Use the periodic table to find the following:

1. The atomic number of: osmium, sodium, lead, chlorine.

2. The relative atomic mass of: helium, barium, europium, oxygen.

3. The number of protons in: mercury, iodine, calcium.

4. The symbol for: gold, lead, copper, iron.

5. The name of: Sr, Na, Ag, Hg.

6. THInK can be written using a combination of the symbols for Thorium, Indium and Potassium (ThInK). Which combinations of element symbols could be used to make the following words?

   AMERICA, FUN, PIRATE, LIFESPAN, FRACTION, EROSION, DYNAMO

5. Research skills

Activity 7: research activity

Use your online searching abilities to see if you can find out as much about the topic as you can. Remember it you are a prospective A level chemist, you should aim to push your knowledge.

Choose 2 of the following tasks and make a 1-page summary for each one you research

Task 1: The chemistry of fireworks

What are the component parts of fireworks? What chemical compounds cause fireworks to explode? What chemical compounds are responsible for the colour of fireworks?

Task 2: Why is copper sulfate blue?

Copper compounds like many of the transition metal compounds have got vivid and distinctive colours – but why?

Task 3: Aspirin

What was the history of the discovery of aspirin, how do we manufacture aspirin in a modern chemical process?

Task 4: The hole in the ozone layer

Why did we get a hole in the ozone layer? What chemicals were responsible for it? Why were we producing so many of these chemicals? What is the chemistry behind the ozone destruction?

Task 5: ITO and the future of touch screen devices

ITO – indium tin oxide is the main component of touch screen in phones and tablets. The element indium is a rare element and we are rapidly running out of it. Chemists are desperately trying to find a more readily available replacement for it. What advances have chemists made in finding a replacement for it?

6. Relative atomic mass (Ar)

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 8

Use the example above to help you work out the answers to the following questions

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?

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?

7. Relative formula mass (Mr)

Carbon dioxide, CO_2 has 1 carbon atom (A_r = 12.0) and two oxygen atoms (A_r = 16.0). The relative formula mass is therefore

$M_r = (12.0 \times 1) + (16.0 \times 2) = 44.0$

Magnesium hydroxide $Mg(OH)_2$ has one magnesium ion (A_r = 24.3) and two hydroxide ions, each with one oxygen (A_r = 16.0) and one hydrogen (A_r = 1.0). The relative formula mass is therefore:

$M_r = (24.3 \times 1) + (2 \times (16.0 + 1.0)) = 58.3$

Activity 9

Use one of the periodic tables in this booklet to calculate the relative formula mass of the following compounds your answers should all be to 1dp:

1. Magnesium oxide MgO

2. Sodium hydroxide NaOH

3. Copper sulfate $CuSO_4$

4. Ammonium chloride NH_4Cl

5. Ammonium sulfate $(NH_4)_2SO_4$

8. 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 10

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

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:

The Periodic Table of the Elements

(1)	(2)											(3)	(4)	(5)	(6)	(7)	(0)
1																	18
1 H hydrogen 1.0	2																2 He helium 4.0
3 Li lithium 6.9	4 Be beryllium 9.0											5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2
11 Na sodium 23.0	12 Mg magnesium 24.3	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	57–71 lanthanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium	85 At astatine	86 Rn radon
87 Fr francium	88 Ra radium	89–103 actinoids	104 Rf rutherfordium	105 Db dubnium	106 Sg seaborgium	107 Bh bohrium	108 Hs hassium	109 Mt meitnerium	110 Ds darmstadtium	111 Rg roentgenium	112 Cn copernicium		114 Fl flerovium		116 Lv livermorium		

Key
atomic number
Symbol
name
relative atomic mass

57 La lanthanum 138.9	58 Ce cerium 140.1	59 Pr praseodymium 140.9	60 Nd neodymium 144.2	61 Pm promethium 144.9	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.2	65 Tb terbium 158.9	66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.0	71 Lu lutetium 175.0
89 Ac actinium	90 Th thorium 232.0	91 Pa protactinium	92 U uranium 238.1	93 Np neptunium	94 Pu plutonium	95 Am americium	96 Cm curium	97 Bk berkelium	98 Cf californium	99 Es einsteinium	100 Fm fermium	101 Md mendelevium	102 No nobelium	103 Lr lawrencium

NaCl	
Na^+	Cl^-
+1	-1

MgO	
Mg^{2+}	O_{2-}
+2	–2

$MgCl_2$	
	Cl^-
Mg^{2+}	Cl^-
+2	–2

Activity 11

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

9. Diatomic molecules and formula of common compounds

A number of atoms exist in pairs as diatomic (two atom) molecules. The common ones that you should remember are:

Hydrogen H_2, Oxygen O_2, Fluorine F_2, Chlorine Cl_2, Bromine Br_2, Nitrogen N_2 and Iodine I_2

There are several common compounds from your GCSE studies that have names that do not help to work out their formulas. For example, water is H_2O.

Activity 12: Research activity

Use the internet or your knowledge to state the formulas of the following compounds?

1. Methane
2. Ammonia
3. Hydrochloric acid
4. Sulfuric acid
5. Sodium hydroxide
6. Potassium manganate(VII)
7. Hydrogen peroxide

10. Balancing equations

Chemical reactions never create or destroy atoms. They are only rearranged or joined in different ways. When hydrogen and oxygen react to make water:

hydrogen + oxygen $\rightarrow$ water

$H_2 + O_2 \rightarrow H_2O$

There are two hydrogen atoms on both sides of this equation, but two oxygen atoms on the left and only one on the right. This is not balanced.
This can be balanced by writing:
$2H_2 + O_2 \rightarrow 2H_2O$
The reactants and products in this reaction are known and you can't change them. The compounds can't be changed, and neither can the subscripts because that would change the compounds. So, to balance the equation, a number must be added in front of the compound or element in the equation. This is a coefficient. Coefficients show how many atoms or molecules there are.

Activity 13

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

11. Moles

A mole is the amount of a substance that contains 6.02×10^{23} particles.
The mass of 1 mole of any substance is the relative formula mass (M_r) in grams.
Examples:
One mole of carbon contains 6.02×10^{23} particles and has a mass of 12.0 g
Two moles of copper contain 12.04×10^{23} particles, and has a mass of 127 g
1 mole of water contains 6.02×10^{23} particles and has a mass of 18 g
The amount in moles of a substance can be found by using the formula:

$$\text{Amount in moles of a substance} = \frac{\text{mass of substance}}{\text{relative formula mass}}$$

Activity 14

Fill in the table.

Substance	Mass of substance	Amount/moles	Number of particles
Helium			18.12×10^{23}
Chlorine	14.2		
Methane		4	
Sulfuric acid	4.905		

12. Empirical formula

(You may not have covered this at GCSE - give it a go and we will go over it again at A level)
If you measure the mass of each reactant used in a reaction, you can work out the ratio of atoms of each reactant in the product. This is known as the empirical formula. This may give you the actual chemical formula, as the actual formula may be a multiple of this. For example, hydrogen peroxide is H2O2 but would have the empirical formula HO.
Use the following to find an empirical formula:
1. Write down reacting masses
2. Find the amount in moles of each element
3. Find the ratio of moles of each element
Example: A compound contains 2.232 g of ion, 1.284 g of sulfur and 1.920 g of oxygen. What is the empirical formula?

Element	Iron	Sulfur	Oxygen
mass/relative atomic mass	2.232/55.8	1.284/32.1	1.920/16.0
Amount in moles	0.040	0.040	0.120
Divide by smallest value	0.040/0.040	0.040/0.040	0.120/0.040
Ratio	1	1	3

So the empirical formula is $FeSO_3$.
If the question gives the percentage of each element instead of the mass, replace mass with the percentage of an element present and follow the same process.

Activity 15

Work out the following empirical formulas:

1. The smell of a pineapple is caused by ethyl butanoate. A sample is known to contain only 0.180 g of carbon, 0.030 g of hydrogen and 0.080 g of oxygen. What is the empirical formula of ethyl butanoate?

2. Find the empirical formula of a compound containing 0.0578 g of titanium, 0.288 g of carbon, 0.012 g of hydrogen and 0.384 g of oxygen.

3. 300 g of a substance are analysed and found to contain only carbon, hydrogen and oxygen. The sample contains 145.9 g of carbon and 24.32 g of hydrogen. What is the empirical formula of the compound?

4. Another 300 g sample is known to contain only carbon, hydrogen and oxygen. The percentage of carbon is found to be exactly the same as the percentage of oxygen. The percentage of hydrogen is known to be 5.99%. What is the empirical formula of the compound?

Answers to activities in Transition guide

You can find answers to the activities in the Transition guide in the tables below.

Activity 1
1. Grams
2. Seconds
3. Nanometres/picometres
4. cm^3
5. Mole
6. kelvin/kilo kelvin

Activity 2

1. 300 seconds
2. 172 800 seconds
3. 5500 kg/5.5 × 10^3 kg

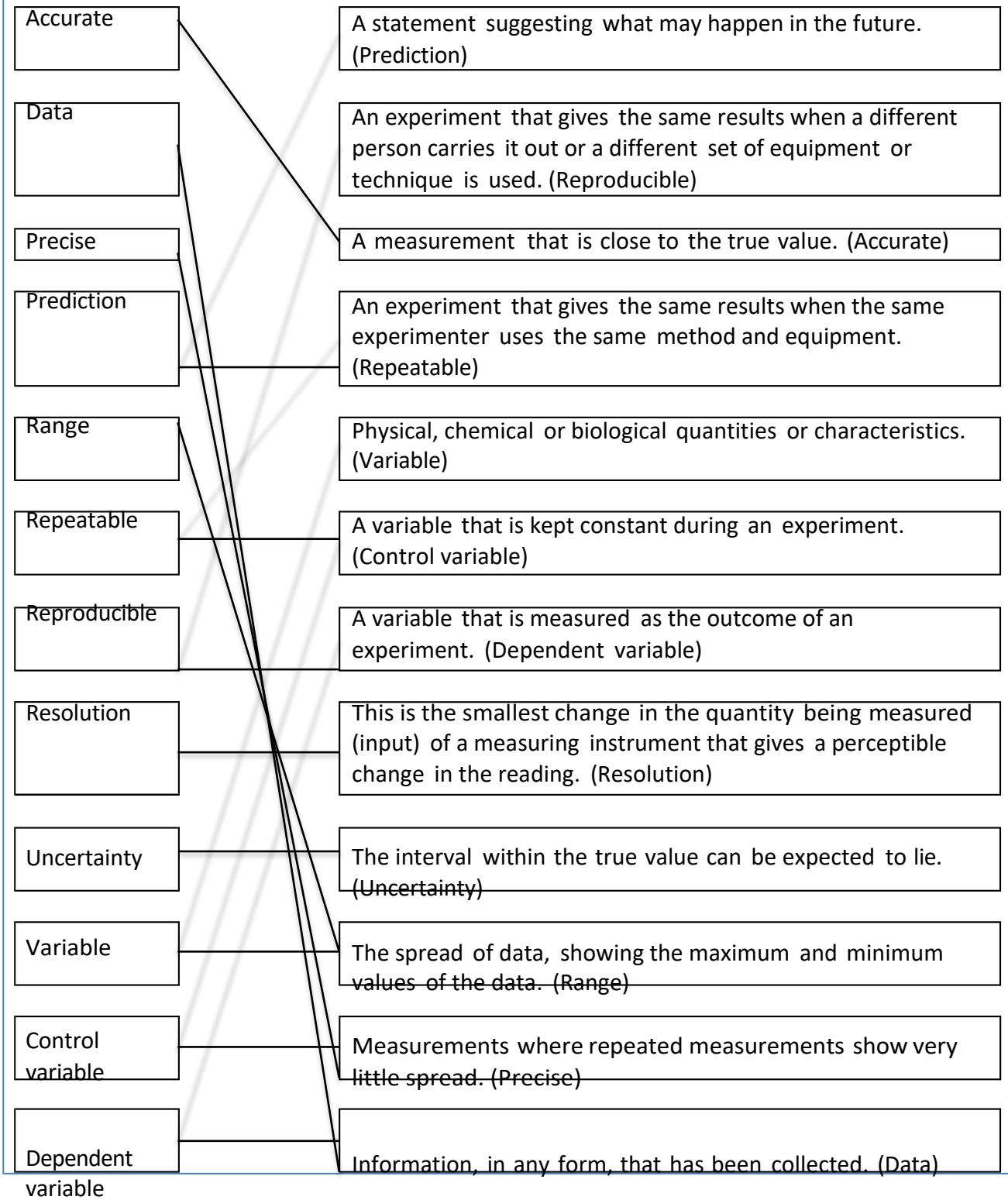
Activity 3

1. 1.22 mm
2. 0.000 104 g
3. 1120.2 m
4. 7000 ml
5. 7 l (also written as 7 dm^3)
6. 0.01 l (0.01 dm^3)

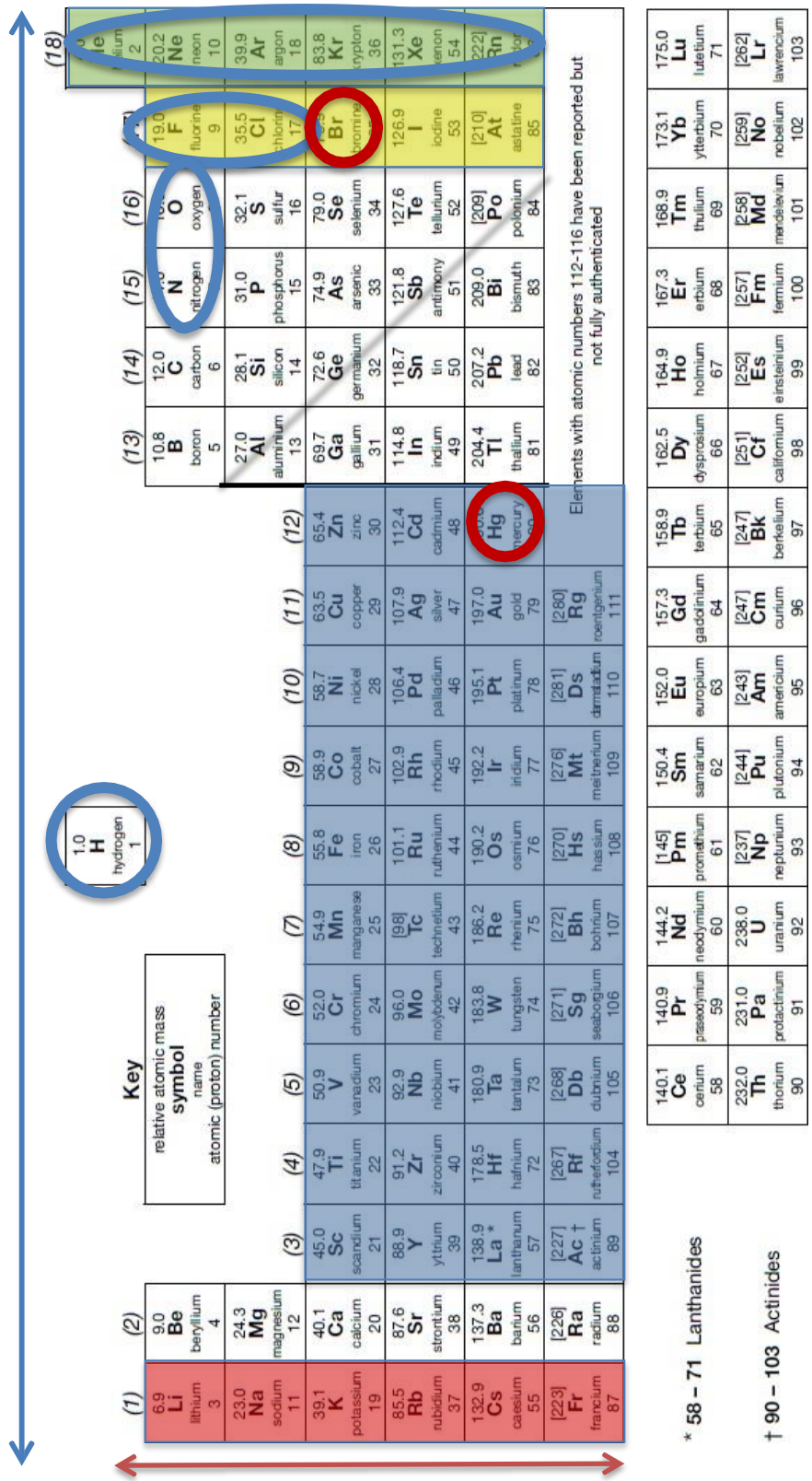
It is worth stressing to students here that in Chemistry, dm^3 is used rather than litres.

Activity 4

Join the boxes to link the word to its definition.



Activity 5



Note- the distinction between metals and non-metals is not clear, so the line may be on either side of these elements.

Activity 6

1. Os: 76 Na: 11 Pb: 82 Cl: 17
2. He: 4.0 Ba: 137.3 Eu: 152.0 O: 16.0
3. Hg: 80 I: 53 Ca: 20
4. Gold: Au Lead: Pb Copper: Cu Iron: Fe
5. Sr: Strontium Na: Sodium Ag: Silver Hg: Mercury
6. AMERICA: Americium; Erbium; Iodine; Calcium
   FUN: Fluorine; Uranium; Nitrogen
   PIRATE: Phosphorus; Iodine; Radium; Tellurium
   LIFESPAN: Lithium; Iron; Sulfur; Protactinium; Nitrogen
   FRACTION: Francium; Actinium; Titanium; Oxygen; Nitrogen
   EROSION: Erbium; Oxygen; Sulfur; Iodine; Oxygen; Nitrogen
   DYNAMO: Dysprosium; Sodium; Molybdenum

Activity 7 is an individual project.

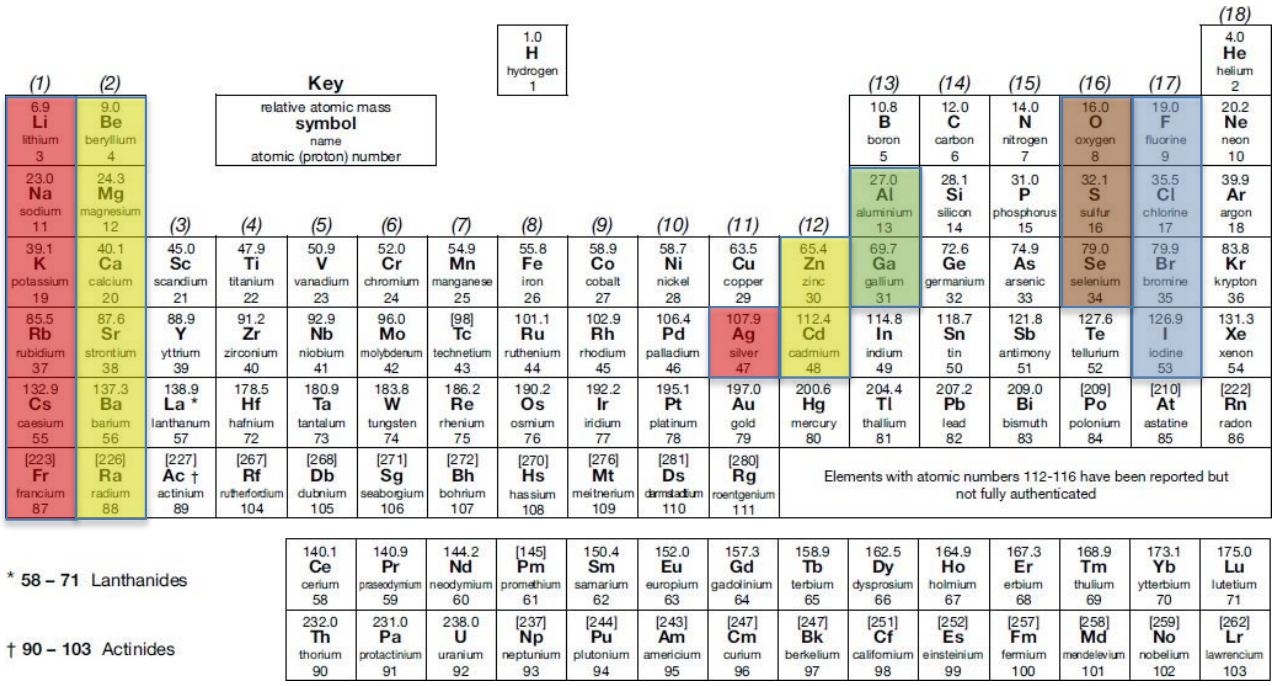
Activity 8

1. 80.0
2. 20.179 (20.2)
3. 24.32 (24.3)
4. 20% ^{10}B and 80% ^{11}B
5. 75% ^{63}Cu and 25% ^{65}Cu

Activity 9

1. 40.3
2. 40.0
3. 159.6
4. 53.5
5. 132.1

Activity 10



(1)	(2)											(13)	(14)	(15)	(16)	(17)	(18)
		Key					1.0 H hydrogen 1										4.0 He helium 2
6.9 Li lithium 3	9.0 Be beryllium 4	relative atomic mass symbol name atomic (proton) number										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	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(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						

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
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

* 58 – 71 Lanthanides

† 90 – 103 Actinides

This shows only compounds with a single ionic form. GCSE students would be expected to know groups 1, 2, 16 and 17

Activity 11

1. $MgBr_2$
2. BaO
3. $ZnCl_2$
4. NH_4Cl
5. $(NH_4)_2CO_3$
6. $AlBr_3$
7. $FeSO_4$
8. $Fe_2(SO_4)_3$

Activity 12

1. CH_4
2. NH_3
3. HCl
4. H_2SO_4
5. NaOH
6. $KMnO_4$
7. H_2O_2

Activity 13

1. $4Al + 3O_2 \rightarrow 2Al_2O_3$
2. $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
3. $2Al + 3Br_2 \rightarrow 2AlBr_3$
4. $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$
5. $Al_2(SO_4)_3 + 3Ca(OH)_2 \rightarrow 2Al(OH)_3 + 3CaSO_4$
6. $3AgNO_3 + K_3PO_4 \rightarrow Ag_3PO_4 + 3KNO_3$
7. $2KMnO_4 + 16HCl \rightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$

Activity 14

Substance	Mass of substance/g	Amount/moles	Number of particles
Helium	12.0	3	1.812×10^{24}
Chlorine	14.2	0.2	1.204×10^{23}
Methane	64.0	4	2.408×10^{24}
Sulfuric acid	4.905	0.05	3.0×10^{22}

Activity 15

1.

Element	Carbon	Hydrogen	Oxygen
Mass/relative atomic mass	0.180/12.0	0.030/1.0	0.080/16.0
Amount in moles	0.015	0.030	0.005
Divide by smallest value	0.015/0.005	0.030/0.005	0.005/0.005
Ratio	3	6	1

Empirical formula: C_3H_6O (Chemical formula: $C_6H_{12}O_2$).

2.

Element	Titanium	Carbon	Hydrogen	Oxygen
mass/relative atomic mass	0.0578/ 47.9	0.288/12.0	0.012/1.0	0.384/16.0
Amount in moles	0.00121	0.024	0.012	0.024
Divide by smallest value	0.00121/ 0.00121	0.024/ 0.00121	0.012/ 0.00121	0.024/ 0.00121
Ratio	1	19.8	9.9	19.8

Empirical formula: $TiC_{20}H_{10}O_{20}$.

3.

Element	Carbon	Hydrogen	Oxygen
Mass/relative atomic mass	145.9/12.0	24.32/1.0	129.78/16.0
Amount in moles	12.16	24.3243	8.11
Divide by smallest value	12.16/8.11	24.32/8.11	8.11/8.11
Ratio	1.5	3	1

Empirical formula: $C_3H_6O_2$

4.

Element	Carbon	Hydrogen	Oxygen
% mass	(100-5.99)/2 =47.005	5.99	(100-5.99)/2 =47.005
% mass/relative atomic mass	3.9171	5.99	2.9378
Divide by smallest value	1.33	2.04	1
Ratio	4	6	3

Empirical formula: $C_4H_6O_3$