Transition to A-level Chemistry

FAKENHAM ACADEMY

Name _____

Contents

Welcome

We are delighted you have chosen to study Chemistry A level next year at Fakenham Academy. A-level Chemistry is an exciting, challenging, and immersive subject that you will find both interesting and fulfilling. Chemistry students get to investigate a range of ideas: the big question you'll ask yourself is 'what is the world made of?'.

Studying Chemistry after GCSE really develops your practical and mathematical skills. If you choose Chemistry as a career, you have the potential to help solve all sorts of problems. You could work on a cure for cancer, develop new food, work on sustainability, the opportunities are endless. Even if you don't directly go into the field of chemistry, the A-level provides you with so many transferable skills that universities and the job market are looking for. You'll develop research, problem solving, analytical skills, alongside teamwork and communication.

This booklet will provide you with the information you need to know about what you are studying during the two year course. As well as this we have put together some information on topics from your GCSE that we will be building on in your first year, some suggested reading and videos to watch. In addition we have added some tasks and a transition test that we would like you to complete before September. These tasks are important to complete so that you have the correct level of background knowledge needed to start the course.

Qualification at a glance

Specification: - OCR Chemistry A (H432)

https://www.ocr.org.uk/images/171720-specification-accredited-a-level-gce-chemistry-a-h432.pdf

Assessment: - OCR Chemistry A consists of three externally examined papers and the Science Practical Endorsement. Students are expected to carry out core practical experiments that are identified in the content. You will be assessed for practical skills when carrying out these experiments and your corresponding write-ups. The content also features heavily in the exam, similarly to the format at GCSE.

Students complete three exam papers in May/June

Paper 1 – Physical and Inorganic Chemistry (2 hours 15 minutes), worth 37% of the overall grade.

Paper 2 – Organic Chemistry (2 hours15 minutes), worth 37% of the overall grade.

Paper 3 – Unified paper (1 hour 30 minutes), worth 26 % of the overall grade.

Content

The field of chemistry is divided in to three distinctive areas; physical, organic and inorganic chemistry. The A-level course is also divided this way, and all year 13 content builds upon the work previously studied in year 12. The practical aspects are studied throughout.

Year 12

Physical Chemistry – Topics include: atomic structure, amount of substance, redox reactions electrons, bonding, shape of molecules, energetics, kinetics and equilibria.

Inorganic Chemistry – Topics include: periodicity, group 2 and group 7.

Organic Chemistry – Topics include: alkanes, halogenalkanes, alkenes, alcohols and organic analysis.

Year 13

Physical Chemistry – Topics include: thermodynamics, rate equations, equilibrium, electrode potentials and acid and bases.

Inorganic Chemistry – Topics include: period 3 elements and their oxides, transition metals and reactions of ions in aqueous solution.

Organic Chemistry – Topics include: isomerism, aldehydes and ketones, carboxylic acids, aromatic chemistry, polymers, nitrogen containing compounds, amino acids and DNA, organic synthesis, NMR spectroscopy and chromatography.

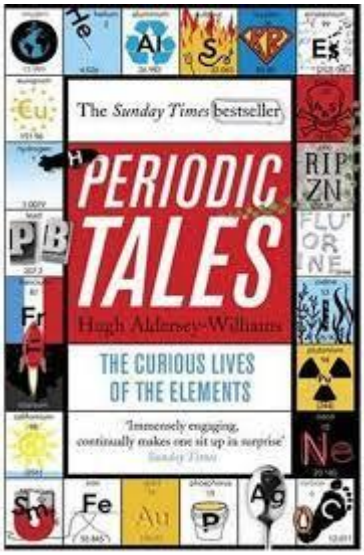
Books you might want to read?

Fakenham Library has a copy of both of these books. Please do not feel you need to purchase them.

Periodic Tales: The Curious Lives of the Elements (Paperback)

Hugh Aldersey-Williams

ISBN-10: 0141041455

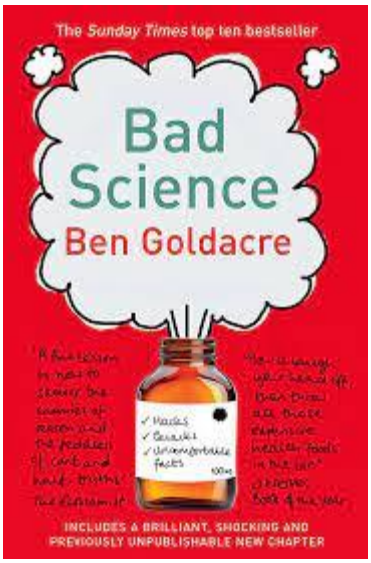


The phenomenal Sunday Times bestseller Periodic Tales by Hugh Andersey-Williams, packed with fascinating stories and unexpected information about the building blocks of our universe.

Bad Science (Paperback)

Ben Goldacre

ISBN-10: 000728487X



Since 2003 Dr Ben Goldacre has been exposing dodgy medical data in his popular Guardian column. In this eye-opening book he takes on the MMR hoax and misleading cosmetics ads, acupuncture and homeopathy, vitamins and mankind's vexed relationship with all manner of 'toxins'. Along the way, the self-confessed 'Johnny Ball cum Witchfinder General' performs a successful detox on a Barbie doll, sees his dead cat become a certified nutritionist and probes the supposed medical qualifications of 'Dr' Gillian McKeith. Full spleen and satire, Ben Goldacre takes us on a hilarious, invigorating and ultimately alarming journey through the bad science we are fed daily by hacks and quacks.

Videos to watch.

Rough science – the Open University – 34 episodes available
Real scientists are 'stranded' on an island and are given scientific problems to solve using only what they can find on the island. Great fun if you like to see how science is used in solving problems. There are six series in total.
https://www.youtube.com/watch?v=lUoDWAt259I

Chemistry in Films Dantes Peak 1997: Volcano disaster movie. Use the link to look at the Science of acids and how this links to the movie.
https://www.open.edu/openlearn/science-maths-technology/science/chemistry/dantespeak

A thread of Quicksilver – The Open University A brilliant history of the most mysterious of elements – mercury. This program shows you how a single substance led to empires and war, as well as showing you come of the cooler properties of mercury.
https://www.youtube.com/watch?v=t46lvTxHHTA

The most AMAZING chemical Reactions - Good demonstration reactions
https://www.youtube.com/watch?v=0Bt6RPP2ANI

SENCA
Log into SENECA and link yourself to the class - f7xq68x6vr or scan the below QR code. Chemistry: OCR A Level Preparation - Summer 2025, there is also a link to the Chemistry OCR A course if you want to have a look.

So what should I go over before September?

1 – Chemical equations

Balancing chemical equations is the stepping stone to using equations to calculate masses in chemistry. Some of the equations to balance may involve a strange chemical, don't worry about that, the key idea is to get balancing right.

Here's a simulation to help with balancing if you find it hard:
https://phet.colorado.edu/en/simulation/balancing-chemical-equations

Balance the following equations:

1. .....C + ...O_2 ⟶ .....CO

2. .....Ba + ...H_2O ⟶ .....$Ba(OH)_2$ + ...H_2

3. .....C_2H_6 + ...O_2 ⟶ .....CO_2 + ...H_2O

4. .....HCl + ...$Mg(OH)_2$ ⟶ .....$MgCl_2$ + H_2O

5. .....N_2 + ...O_2 ⟶ .....NO

6. .....Fe_2O_3 + ...C ⟶ .....Fe + ...CO_2

7. .....CH_3 CH_2OH + ...[O] ⟶ .....CH_3 COOH + ...H_2O

8. .....HNO_3 + ...CuO ⟶ .....$Cu(NO_3)_2$ + H_2O

9. .....Al^{3+} + ...e^- ⟶ .....Al

10. .....$[Fe(H_2O)_6]^{3+}$ + ...CO_3^{2-} ⟶ .....$Fe(OH)_3(H_2O)_3$ + ...CO_2 + ...H_2O

2 – The Mole

From this point on you need to be using an A level periodic table, not a GCSE one you can view one here:

https://www.ocr.org.uk/Images/302736-units-h033-and-h433-data-sheet.pdf

Now that we have our chemical equations balanced, we need to be able to use them in order to work out masses of chemicals we need or we can produce. The mole is the chemists equivalent of a dozen, atoms are so small that we cannot count them out individually, we weigh out chemicals.

For example:

magnesium + sulphur → magnesium sulphide

$$Mg + S \rightarrow MgS$$

We can see that one atom of magnesium will react with one atom of sulphur, if we had to weigh out the atoms we need to know how heavy each atom is.

From the periodic table:

Mg = 24.3 and S = 32.1

If I weigh out 32.1g of sulphur then I would have 1 mole of sulphur atoms.

So 24.3g of Mg will react precisely with 32.1g of sulphur, and will make 56.4g of magnesium sulphide.

At the website show below you will find some videos and activities.
http://www.chemteam.info/Mole/Mole.html

Questions

a) How many moles of water are in 50g?

b) How many moles of potassium are in 100g of potassium choride?

c) How many moles of water are in 300g of hydrated magnesium sulfate(VI)

($MgSO_4.7H_2O$)? The dot followed by $7H_2O$ means that the molecule comes with 7 water

molecules so these have to be counted in as part of the molecules mass.

d) What mass is 0.28 moles of ethanol (CH_3CH_2OH)?

e) If I have 2.4g of magnesium, how many g of oxygen(O_2) will I need to react completely

with the magnesium? $2Mg + O_2 \rightarrow MgO$

3 – Solutions and Concentrations

The dm^3 is a cubic decimetre, it is 1 litre or $1000cm^3$ but from this point on as an A level chemist you will use the dm^3 as your volume measurement.

http://www.docbrown.info/page04/4_73calcs11msc.htm

Questions

a) What is the concentration (in mol dm^{-3}) of 9.53g of magnesium chloride ($MgCl_2$) dissolved in $100cm^3$ of water?

b) What is the concentration (in mol dm^{-3}) of 13.248g of lead nitrate ($Pb(NO_3)_2$) dissolved in $2dm^3$ of water?

c) If I add $100cm^3$ of 1.00 mol dm^3 HCl to $1.9dm^3$ of water, what is the molarity of the new solution?

d) What mass of silver is present in $100cm^3$ of 1moldm^{-3} silver nitrate ($AgNO_3$)?

e) The Dead Sea, between Jordan and Israel, contains 0.0526 moldm^{-3} of Bromide ions (Br^-), what mass of bromine is in $1dm^3$ of Dead Sea water?

4 – Titrations

One of the early key principles you will review is the titration and the associated calculation.

https://www.youtube.com/watch?v=RI14t0R1wMY

Remember for any titration calculation you need to have a balanced symbol equation; this will tell you the ratio in which the chemicals react.

For example: A titration of an unknown sample of sulphuric acid with sodium hydroxide. A $25.00cm^3$ sample of the unknown sulphuric acid was titrated with 0.100moldm^{-3} sodium hydroxide and required exactly $27.40cm^3$ for neutralisation.

What is the concentration of the sulphuric acid?

Step 1: the equation $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

Step 2; the ratios 2 : 1

Step 3: how many moles of sodium hydroxide 27.40cm3 = $0.0274dm^3$

number of moles = c x v = 0.100 x 0.0274 = 0.00274 moles

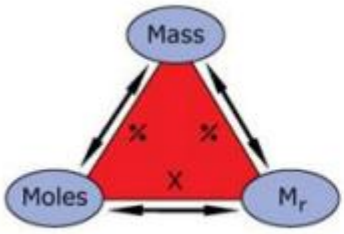
Step 4: Using the ratio, how many moles of sulphuric acid for every 2 NaOH there are 1 H_2SO_4 so, we must have 0.00274/2 =0.00137 moles of H_2SO_4

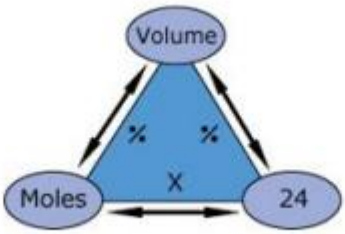
Step 5: Calculate concentration. concentration = moles/volume in dm3 = 0.00137/0.025 = 0.0548 moldm^{-3}

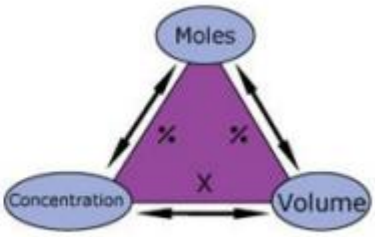
Here are some additional problems, which are harder, ignore the questions about colour changes of indicators.
http://www.docbrown.info/page06/Mtestsnotes/ExtraVolCalcs1.htm

Use the steps on this page to help you.

Rember these formula triangles – Including the one in the middle on volume. 24 dm3 = 1 mole of any gas!







1. Calculate the mass of each of the following

(a) 2.50 mol of hydrogen, $H_2(g)$

(b) 0.500 mol of sodium chloride, NaCl.

2. Calculate the amount (in mol) of each substance listed below:

a) 31.0 g of phosphorus molecules, P_4

b) 50.0 g of calcium carbonate, $CaCO_3$

3. Calculate the molar mass of an 11g gas sample of compound X, which is 0.25mol.

Molar mass: _____ $gmol^{-1}$

Possible identity of the gas sample X: _____

4. Calculate the amount of gas (in mol) of:

(a) 3600cm^3 of hydrogen gas, H_2

Amount of H_2 gas: _____ mol

(b) 4dm^3 of hydrogen gas, CO_2

Amount of CO_2 gas: _____ mol

5. Calculate the volume of gas:

(a) 6 mol of sulfur dioxide gas, SO_2

Volume of SO_2 gas: _____ dm^3

(b) 0.25mol of oxygen gas, O_2

Volume of O_2 gas: _____ cm3

6. Calculate the volume produced in the following solutions:

(a) A solution with a concentration of 2 $moldm^{-3}$ that contains 2 moles of solute.

Volume of solution: _____ dm^3

(b) a solution with a concentration of 0.25 $moldm^{-3}$ that contains 0.005 moles of solute.

Volume of solution: _____ dm^3

7. Use this formula to calculate the concentration (in $moldm^{-3}$) for the following solutions:

(a) 0.5 moles of solid dissolved in 250cm^3 of solution

Concentration: _____ $moldm^{-3}$

(b) 0.00875 moles of solid dissolved in 25cm^3 solution

Concentration: _____ $moldm^{-3}$

8. Find the mass concentration, in gdm^{-3} , for the following solutions:

(a) 0.0042 moles of HNO_3 dissolved in 250cm^{-3} of solution

Mass concentration: _____ gdm^{-3}

(b) 0.5 moles of HCl dissolved in 4dm^3 of solution

Mass concentration: _____ gdm^{-3}

9. The following reaction can take place, shown in this equation:

$$NaHCO_3(s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(l)$$

(a) Balance the equation shown above

(b) What volume of CO_2 is formed by the decomposition of 5.04g of $NaHCO_3$?

Volume of CO_2: _____ dm^3

10. The following reaction can take place, shown in this equation:

$$MgCO_3(s) + HNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + CO_2(g) + H_2O(l)$$

(a) Balance the equation shown above

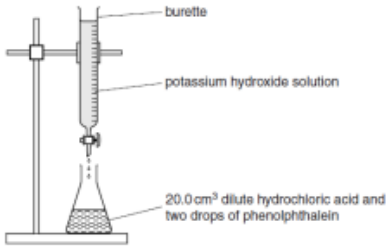
(b) 2.529g of $MgCO_3$ reacts with an excess of HNO_3. What volume of CO_2 is formed?

(c) The final volume of the solution is 50.0cm^3 . What is the concentration of $Mg(NO_3)_2(aq)$ formed?

11, Look at the equation for the reaction between potassium hydroxide and hydrochloric acid.

$$KOH + HCl \rightarrow KCl + H_2O$$

Look at the apparatus she uses.



Calculate the concentration of potassium hydroxide in mol/dm^3

These hints might help:

- Work out the number of moles in 20.0 cm^3 of 0.200 mol/dm^3 hydrochloric acid.
- Work out the number of moles of potassium hydroxide neutralised.
- Work out the average titre, in cm^3, using titration numbers 2,3 and 4.

Titration Number	1	2	3	4
Final burette reading in cm^3	26.9	27.6	27.0	28.2
Initial burette reading in cm^3	0.5	2.5	2.0	3.3
Titre (Volume of alkali used) in cm^3	26.4	25.1	25.0	24.9

12. A solution of barium nitrate will react with a solution of sodium sulphate to produce a precipitate of barium sulphate.

$$Ba(NO_3)_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2NaNO_3(aq)$$

What volume of 0.25moldm^{-3} sodium sulphate solution would be needed to precipitate all the barium from 12.5cm^3 of 0.15 moldm^{-3} barium nitrate?

5 – Electronic Structure - How electrons are arranged around the nucleus.

A periodic table can give you the proton / atomic number of an element, this also tells you how many electrons are in the atom. You will have used the rule of electrons shell filling, where: The first shell holds up to 2 electrons, the second up to 8, the third up to 8 and the fourth up to 18 (or you may have been told 8).

Atomic number = 3,

Electrons = 3,

Arrangement = 2 in the first shell and 1 in the second or Li = 2,1

At A level you will learn that the electron structure is more complex than this. An electron SHELL is really and ENERGY LEVEL rather than a position in space. Electrons do not really orbit aa nucleus like planets round a solar system. The 'shells' can be broken down into 'orbitals' which are which are given letters: 's' orbitals, 'p' orbitals and 'd' orbitals. You can read about orbitals here:
http://www.chemguide.co.uk/atoms/properties/atomorbs.html#top

You will be taught this is in your first topic, Elements of Life. Please move on if you don't want to practice these. THIS IS NEW.

If you want to practice then now that you know electrons are in principle energy levels (1,2,3,4,5 etc) which are divided up into sublevels called orbitals labelled as s, p and d orbitals. Try these problems, write your answer in the format: $1s^2$, $2s^2$, $2p^6$ etc.

Question

Write out the electron configuration of:

a) Ca b) Al c) S d) Cl e) Ar f) Fe g) V h) Ni i) Cu j) Zn k) As

Extension question, can you write out the electron arrangement of the following ions:

a) K^+ b) O^{2-} c) Zn^{2+} d) V^{5+} e) Co^{2+}

6 – Oxidation and Reduction

At GCSE you know that oxidation is adding oxygen to an atom or molecule and that reduction is removing oxygen, or that oxidation is removing hydrogen and reduction is adding hydrogen. You may have also learned that oxidation is removing electrons and reduction is adding electrons.

At A level, we use a term OXIDATION NUMBER, which helps us understand when something has been oxidised or reduced. If the number gets smaller, then it is reduced; bigger and it is oxidised.

The OXIDATION NUMBER is the charge an element has if it was an ion! You know that the metals in group 1 react to form ions that are +1, i.e. Na^+ and that group 7, the halogens, form -1 ions, i.e. Br^-. We say that sodium, when it has reacted has an oxidation number of +1 and that bromide has an oxidation number of -1. All atoms that are involved in a reaction can be given an oxidation number. An element, Na or O_2 is always given an oxidation state of zero (0), any element that has reacted has an oxidation state of + or -.

As removing electrons is reduction, if, in a reaction the element becomes more negative it has been reduced, if it becomes more positive it has been oxidised. You can read about the rules for assigning oxidation numbers here:

http://www.dummies.com/how-to/content/rules-for-assigning-oxidation-numbers-toelements.html

Elements that you expect to have a specific oxidation state actually have different states, so for example you would expect chlorine to be -1, it can have many oxidation states: NaClO, in this compound it has an oxidation state of +1

There are a few simple rules to remember: Metals have a + oxidation state when they react. Oxygen is 'king' it always has an oxidation state of -2. Hydrogen has an oxidation state of +1 (except metal hydrides) The charges in a molecule must cancel.

Examples:

What is the oxidation number of Nitrogen in Sodium nitrate, $NaNO_3$?

Na has an oxidation number of +1

Oxygen has an oxidation number of 2- but there are 3 of them so you multiply by 3 = 6-

But overall $NaNO_3$ has no charge so +1 -6 +(N) = 0 so N must be +5 N = +5

What is the oxidation number of sulphur in a sulphate ion, SO_4^{2-}

4 x O^{2-} = 8- Overall ionic charge is 2- so -9 + (S) = -2, so S must be +6 S = +6

Question

Work out the oxidation state of the underlined atom in the following:

a) $MgCO_3$

b) SO_3

c) $NaClO_3$

d) MnO_2

e) Fe_2O_3

f) V_2O_5

g) $KMnO_4$

h) $Cr_2O_7^{2-}$

i) Cl_2O_4

7 – Organic Chemistry

You know what molecules look like that are called alkanes, alkenes. You may have also covered alcohols, carboxylic acids and esters. These different molecules behave different due to the different FUNCTIONAL GROUPS in them.

During you're A level you are going to meet a selection of the functional groups, learn a little about their properties and how we give them logical names. You will find a menu for organic compounds here:

http://www.chemguide.co.uk/orgpropsmenu.html#top

And how to name organic compounds here:

http://www.chemguide.co.uk/basicorg/conventions/names.html#top

Using the two links see if you can answer the following questions:

Questions

1) Draw:

a) heptane

b) but-1-ene

c) 2methylbutane

d) propanoic acid

e) propyl ethanoate

f) ethyl propaoate

2) What is made when propene reacts with Cl_2?

3) What two different molecules can be made when propene reacts with HCl?

4) Alcohols - How could you make ethanol from ethene?

5) How does ethanol react with sodium, in what ways is this:

   a) similar to the reaction with water,

   b) different to the reaction with water?

6) NEW MOLECULES - Aldehydes and ketones Look up and draw the structures of:

   a) propanal

   b) propanone

   c) How are these two functional groups different?

8 Acids, Bases, pH

At GCSE you will know that an acid can dissolve in water to produce H^+ ions, at A level you will need a greater understanding of what an acid or a base is. Read the following page on Theory of acids and bases:
http://www.chemguide.co.uk/physical/acidbaseeqia/theories.html#top

Read the following pages on Weak acids and bases
http://www.chemguide.co.uk/physical/acidbaseeqia/acids.html#top

Questions

1) Write your own new definition of an acid and a base.

2) Show how sulphuric acid acts as an acid.

3) Show how ammonia acts as a base.

4) Explain the idea of strong and weak acids and why this is different to concentrated or dilute acids.

5) Explain why ethanoic acid is a weaker acid than HCl.

Transition Test

(Please scan in and send to h.collinge@fakenhamacademy.org) if you don't have a scanner Camscanner is a good app to scan using your phone and is free to use.)

Circle the correct answer:

1 Which row shows the atomic structure of an atom of the 19F isotope?

	Protons	Neutrons	Electrons
A	9	9	10
B	9	10	9
C	10	9	10
D	10	10	9

[1]

2. Which row shows the numbers of neutrons and electrons in an $^{56}Fe^{3+}$ ion?

	Neutrons	Electrons
A	26	27
B	29.8	56
C	30	23
D	33	20

[1]

3. What is the total number of electrons in a nitrate ion, NO^{3-}?

A 32

B 33

C 47

D 64

[1]

4. Calcium hydroxide contains Ca^{2+} and OH^- ions. What is the formula of calcium hydroxide?

A CaOH

B $CaOH_2$

C Ca_2OH

D $Ca(OH)_2$

[1]

5. The mass of an object measured on a 4 decimal place balance is 7.0855 g What is this mass to 3 significant figures?

A 7.09 g

B 7.19 g

C 7.085 g

D 7.086 g

[1]

6. Rearrange PV = nRT to make n the subject.

A $n = \frac{RV}{PT}$ **B** $n = \frac{PV}{RT}$

C $n = \frac{RT}{PV}$ **D** $n = \frac{1}{RTPV}$

[1]

7. Lithium reacts with oxygen to form lithium oxide, Li_2O

Which equation is correct for this reaction?

A $Li + O_2 \rightarrow Li_2O$

B $Li + O_2 \rightarrow LiO_2$

C $2Li + O_2 \rightarrow Li_2O_2$

D $4Li + O_2 \rightarrow 2Li_2O$

[1]

8. Balance the equation below:

$$\_\_\_K_3PO_4 + \_\_\_Ca(NO_3)_2 \rightarrow \_\_\_KNO_3 + \_\_\_Ca_3(PO_4)_2$$

[2]

9. What is the relative formula mass of NH_4NO_3?

A 42.0

B 56.0

C 66.0

D 80.0

[1]

10. How many moles of CO_2 are there in 22 g of CO_2?

A 0.25

B 0.5

C 2

D 4

[1]

11. Sodium carbonate contains sodium ions and carbonate ions.

Which statement(s) is/are correct?

A The formula of sodium carbonate is NaCO3.

B The relative formula mass of sodium carbonate is 106.

C A carbonate ion has the formula CO_3^{2-} .

D A sodium ion contains one electron in its outer shell.

[1]

12. A sample of copper contains two isotopes, 63Cu and 65Cu. The relative atomic mass of copper is 63.5. Which statement(s) is/are correct? Circle two letters

A 65Cu has two more neutrons than 63Cu

B 65Cu has two more protons than 63Cu

C 63Cu and 65Cu contain the same number of electrons

D 65Cu has two more electrons than 63Cu

[1]

13. Which statement describes the structure of an atom?

A A sphere of positive charge with electrons embedded in it

B A nucleus containing protons and neutrons, orbited by electrons

C A solid sphere that cannot be divided into smaller parts

D Protons and electrons concentrated in a nucleus, surrounded by orbiting neutrons

[1]

14. Which force holds an atom's nucleus together?

A Electrostatic force

B Electromagnetic force

C Strong nuclear force

D Weak intermolecular interactions

[1]

15. What type of error is caused by results varying around the true value in an unpredictable way?

A Measurement error

B Systematic error

C Random error

D Zero error

[1]

Answer the questions in the spaces provided in this section

16. Describe what it means when results are described as:

accurate:

.....

.....

precise:

.....

.....

[2]

17. This question is about atoms, isotopes and ions.

(a) (i) Complete the table below to show the properties of the particles.

Particle	Relative Mass	Relative Charge
Proton		
Neutron		
Electron		

[3]

(ii) Complete the table for an atom and an ion of two different elements.

Element	Mass Number	Protons	Neutrons	Charge	Electron Configuration
		11	13	0	
	24			2-	2.8.8

[2]

(b) State the similarities and differences between isotopes of the same element.

Similarities.....

.....

Differences.....

.....

[2]

(c) An isotope of an element X contains 56 protons and 56 neutrons. Identify element X and write down the mass number and atomic number of this isotope of X.

element X =.....

Atomic number: .....

Mass number: .....

[3]

18. Describe the function of a mass spectrometer.

.....

.....

.....

[2]