



Guided by Christ, we aspire to achieve



A' level Chemistry

Bridging work

Name.....

Introduction

Welcome to your introductory work for A' level chemistry. I hope you find these activities helpful and engaging whilst preparing for the A' level course.

Some students find the transition from GCSE to A-level Chemistry very challenging. To help make this transition smoother and to give you the best possible start, we have prepared this booklet for you.

The activities here will ensure you secure the basic knowledge from GCSE. It will also allow you to look at chemistry as a whole hopefully extending your knowledge and allowing you to think about what chemistry is all about in the real world.

If you have only done trilogy science at GCSE, the jump from GCSE to A level will be more pronounced and this bridging work becomes even more crucial. It is important that you read through this booklet and then complete **all** the questions.

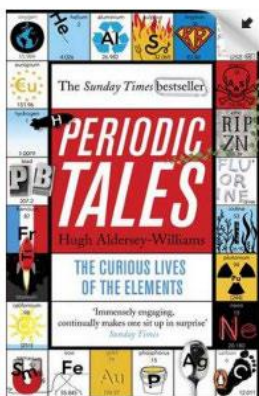
If you use additional paper make sure you also write your name on each sheet of paper. These must be organised in a folder. The tasks cover GCSE topics which you should have already covered. You will need a secure knowledge of these topics before you start the course in September.

To help you complete this booklet the following resources may be useful:

- <http://www.bbc.co.uk/schools/gcsebitesize/>
- <https://s-cool.co.uk/gcse/chemistry>
- Any GCSE Additional Science/ Chemistry revision guide
- Your own old GCSE Science/ Chemistry exercise books
- Head Start to AS Chemistry Published by CGP
- www.chemguide.co.uk
- www.knockhardy.org.uk
- <https://www.khanacademy.org/science/chemistry>

Book Recommendations

If you are planning on studying science further at university then reading science books gives you something to talk about in interviews and your personal statement as well as broadening your understanding of science and how the world works. The list that follows are not the only books you could read but they are a good entry point. I have also included books which may help with aspects of the course. There are no expectations for you to buy these and you will be provided with a text book to use. If you do wish too you can get these second hand cheaply on amazon or eBay.



Periodic Tales: The Curious Lives of the Elements

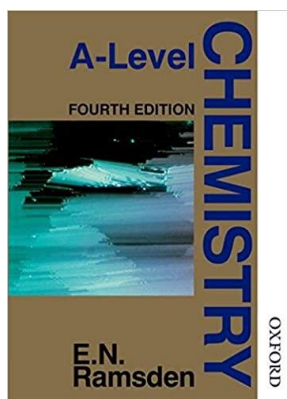
(Paperback) Hugh Aldersey-Williams

ISBN-10: 0141041455

Packed with fascinating stories and unexpected information about the building blocks of our universe. Everything in the universe is made of them, including you. Like you, the elements have personalities, attitudes, talents, shortcomings, stories rich with meaning. Here you'll meet iron that rains from the heavens and noble gases that light the way to vice. You'll learn how lead can tell your future while zinc may one day line your coffin.

You'll discover what connects the bones in your body with the

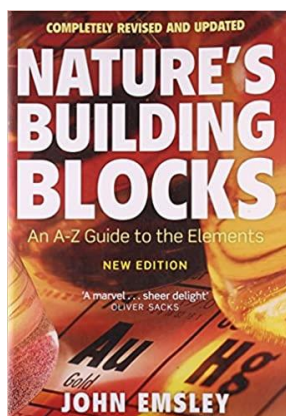
Whitehouse in Washington, the glow of a streetlamp with the salt on your dinner table. Unlocking their astonishing secrets and colourful pasts, Periodic Tales is a voyage of wonder and discovery, showing that their stories are our stories, and their lives are inextricable from our own.



A Level Chemistry (Paperback) E.N. Ramsden

ISBN-10: 0748752994

This book covers all the topics you will need in chemistry so useful and gives a little bit extra with the explanations. A really useful book.



Nature's Building Blocks: An A-Z Guide to the Elements

(Paperback) John Emsley

ISBN-10: **0199605637**

A fascinating guide to all the elements. Each entry gives an explanation of where the element's name comes from, the role it plays in living things, how and when it was discovered, what it is used for), where it occurs and always ends on a surprising fact.

Podcasts

Chemistry World

<https://www.chemistryworld.com/podcasts>

Here you will find information about the elements, atoms and bonds and book reviews.

Chemistry in its element

<https://www.rsc.org/periodic-table/podcast/>

A lovely way to look at all the elements.

Chemistry in Everyday Life

<https://anchor.fm/johannes-vogel0>

Tries to explain the world around us using chemistry.

The naked scientists

<https://www.thenakedscientists.com/science-podcasts>

Has a whole range of interesting topics covered. The website has a lot of great resources too.

New scientist

<https://www.newscientist.com/podcasts/>

Has some great interviews with scientists.

Research Activity (PICK ONE ONLY)

Task 1

Sign up to Education in Chemistry at the Royal Society for Chemistry for Chemical articles and events. It is free to register.

<https://eic.rsc.org/>

In the section Education in Chemistry click the Science tab (fourth tab). You will see articles about hand sanitises, the moon and alloys etc. Choose an interesting article (it does not have to be one of these three).

Make notes and be prepared to explain what you have read.

You can make a 2-page summary for each one you research using Cornell notes:

<http://coe.jmu.edu/learningtoolbox/cornellnotes.html>

Task 2

At the bottom of the Science tab you can view the latest edition of the magazine Education in Chemistry, have a look through for the latest Science research. Make sure that you have read at least one article, have made notes are prepared to discuss it.

Task 3

Challenge Yourself Try the tasks on the Cambridge Chemistry Challenge. How far can you get? Good little chemistry puzzles to get you thinking.

<http://c3l6.com/>

Formula

Elements

Monatomic	Simple molecular	Ionic	Metallic	Giant covalent
helium neon argon krypton xenon radon	hydrogen nitrogen oxygen fluorine chlorine bromine iodine phosphorus sulfur	There are no ionic elements!!	The formula is just the symbol, e.g. magnesium iron sodium nickel	The formula is just the symbol diamond graphite silicon

Compounds

Monatomic	Simple molecular	Ionic	Metallic	Giant covalent
There are no monatomic compounds!!	Some common molecular compounds: carbon dioxide carbon monoxide nitrogen monoxide nitrogen dioxide sulfur dioxide sulfur trioxide ammonia methane hydrogen sulfide	These have to be worked out using ion charges – you have to know these at AS/A level! LEARN them ASAP. Note these acids: hydrochloric acid sulfuric acid nitric acid phosphoric acid	There are no metallic compounds!!	silicon dioxide

Positive ions		Negative ions	
Group 1 ions: lithium sodium potassium Group 2 ions: magnesium calcium barium	Group 3 ions: aluminium Other common ions silver zinc ammonium hydrogen	Group 7 ions: fluoride chloride bromide iodide Group 6 ions: oxide sulfide	Other common ions nitrate sulfate carbonate hydrogencarbonate hydroxide hydride phosphate

TASK 1 – WRITING FORMULAS OF IONIC COMPOUNDS

- | | | | |
|----------------------------|-------|----------------------------|-------|
| 1) silver bromide | ..... | 9) lead (II) oxide | ..... |
| 2) sodium carbonate | ..... | 10) sodium phosphate | ..... |
| 3) potassium oxide | ..... | 11) zinc hydrogencarbonate | ..... |
| 4) iron (III) oxide | ..... | 12) ammonium sulphate | ..... |
| 5) chromium (III) chloride | ..... | 13) gallium hydroxide | ..... |
| 6) calcium hydroxide | ..... | 14) strontium selenide | ..... |
| 7) aluminium nitrate | ..... | 15) radium sulfate | ..... |
| 8) sodium sulfate | ..... | 16) sodium nitride | ..... |

TASK 2 – WRITING FORMULAS 1

- | | | | |
|----------------------|-------|-------------------------|-------|
| 1) lead (IV) oxide | ..... | 11) barium hydroxide | ..... |
| 2) copper | ..... | 12) tin (IV) chloride | ..... |
| 3) sodium | ..... | 13) silver nitrate | ..... |
| 4) ammonium chloride | ..... | 14) iodine | ..... |
| 5) ammonia | ..... | 15) nickel | ..... |
| 6) sulfur | ..... | 16) hydrogen sulfide | ..... |
| 7) sulfuric acid | ..... | 17) titanium (IV) oxide | ..... |
| 8) neon | ..... | 18) lead | ..... |
| 9) silica | ..... | 19) strontium sulfate | ..... |
| 10) silicon | ..... | 20) lithium | ..... |

TASK 3 – WRITING FORMULAS 2

- | | | | |
|---------------------------|-------|--------------------------|-------|
| 1) silver carbonate | ..... | 11) barium hydroxide | ..... |
| 2) gold | ..... | 12) ammonia | ..... |
| 3) platinum (II) fluoride | ..... | 13) hydrochloric acid | ..... |
| 4) nitric acid | ..... | 14) fluorine | ..... |
| 5) ammonia | ..... | 15) silicon | ..... |
| 6) silicon (IV) hydride | ..... | 16) calcium phosphate | ..... |
| 7) phosphorus | ..... | 17) rubidium | ..... |
| 8) diamond | ..... | 18) germanium (IV) oxide | ..... |
| 9) vanadium (V) oxide | ..... | 19) magnesium astatide | ..... |
| 10) cobalt (II) hydroxide | ..... | 20) nitrogen monoxide | ..... |

Writing equations

From an early age you should have been able to balance chemical equations. However, at A level, you will often need to:

- work out the formulas yourselves
- work out what is made (so you need to know some basic general equations)
- for reactions involving ions in solution, write ionic equations

Some general reactions you should know:

General Reaction	Examples
substance + oxygen → oxides	$2 \text{Mg} + \text{O}_2 \rightarrow 2 \text{MgO}$ $2 \text{H}_2\text{S} + 3 \text{O}_2 \rightarrow 2 \text{H}_2\text{O} + 2 \text{SO}_2$ $\text{C}_3\text{H}_8 + 5 \text{O}_2 \rightarrow 3 \text{CO}_2 + 4 \text{H}_2\text{O}$
metal + water → metal hydroxide + hydrogen	$2 \text{Na} + 2 \text{H}_2\text{O} \rightarrow 2 \text{NaOH} + \text{H}_2$
metal + acid → salt + hydrogen	$\text{Mg} + 2 \text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$
oxide + acid → salt + water	$\text{MgO} + 2 \text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2\text{O}$
hydroxide + acid → salt + water	$2 \text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$
carbonate + acid → salt + water + carbon dioxide	$\text{CuCO}_3 + 2 \text{HCl} \rightarrow \text{CuCl}_2 + \text{H}_2\text{O} + \text{CO}_2$
hydrogencarbonate + acid → salt + water + carbon dioxide	$\text{KHCO}_3 + \text{HCl} \rightarrow \text{KCl} + \text{H}_2\text{O} + \text{CO}_2$
ammonia + acid → ammonium salt	$\text{NH}_3 + \text{HCl} \rightarrow \text{NH}_4\text{Cl}$
metal carbonate → metal oxide + carbon dioxide (on heating)	$\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$

TASK 4 – WRITING BALANCED EQUATIONS

1) Balance the following equations.

- $\text{Mg} + \text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2$
- $\text{CuCl}_2 + \text{NaOH} \rightarrow \text{Cu}(\text{OH})_2 + \text{NaCl}$
- $\text{SO}_2 + \text{O}_2 \rightarrow \text{SO}_3$
- $\text{C}_4\text{H}_{10} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$

2) Give balanced equations for the following reactions.

- sodium + oxygen → sodium oxide
- aluminium + chlorine → aluminium chloride
- calcium + hydrochloric acid → calcium chloride + hydrogen
- ammonia + sulphuric acid → ammonium sulphate

Significant figures and standard form

Standard Form

- Standard form is very useful for writing very large or small numbers.
- They are written in the form $A \times 10^n$ where A is a number between 1 and 10.
- n represents the number of places the decimal point is moved (for +n values the decimal point has been moved to the left, for -n values the decimal point has been moved to the right).

Number	3435	1029000	0.025	23.2	0.0000278
Standard form	3.435×10^3	1.029×10^6	2.5×10^{-2}	2.32×10^1	2.78×10^{-5}

- To find the value of n:
 - for numbers greater than 1, n = number of places between first number and decimal place
 - for numbers less than 1, n = number of places from the decimal place to the first number (including that number)

Significant figures

Full number	1 sig fig	2 sig fig	3 sig fig	4 sig fig	5 sig fig
9.378652	9	9.4	9.38	9.379	9.3787
4204274	4000000	4200000	4200000	4204000	4204300
0.903521	0.9	0.90	0.904	0.9035	0.90352
0.00239482	0.002	0.0024	0.00239	0.002395	0.0023948

Significant figures for calculations involving multiplication / division

- Your final answer should be given to the same number of significant figures as the least number of significant figures in the data used.

e.g. Calculate the average speed of a car that travels 1557 m in 95 seconds.

$$\text{average speed} = \frac{1557}{95} = 16 \text{ m/s (answer given to 2 sig fig as lowest sig figs in data is 2 sig fig for time)}$$

e.g. Calculate the average speed of a car that travels 1557 m in 95.0 seconds.

$$\text{average speed} = \frac{1557}{95} = 16.4 \text{ m/s (answer given to 3 sig fig as lowest sig figs in data is 3 sig fig for time)}$$

Significant figures for calculations involving addition/subtraction ONLY

- Here the number of significant figures is irrelevant – it is about the place value of the data. For example

e.g. Calculate the total energy released when 263 kJ and 1282 kJ of energy are released.

$$\text{Energy released} = 263 + 1282 = 1545 \text{ kJ (answer is to nearest unit as both values are to nearest unit)}$$

e.g. Calculate the total mass of calcium carbonate when 0.154 g and 0.01234 g are mixed.

$$\text{Mass} = 0.154 + 0.01234 = 0.166 \text{ g (answer is to nearest 0.001 g as least precise number is to nearest 0.001 g)}$$

TASK 7 – SIGNIFICANT FIGURES & STANDARD FORM

1) Write the following numbers to the quoted number of significant figures.

- | | | | | | |
|------------|------------|-------|-------------|------------|-------|
| a) 345789 | 4 sig figs | ..... | d) 6.0961 | 3 sig figs | ..... |
| b) 297300 | 3 sig figs | ..... | e) 0.001563 | 3 sig figs | ..... |
| c) 0.07896 | 3 sig figs | ..... | f) 0.010398 | 4 sig figs | ..... |

2) Complete the following sums and give the answers to the appropriate number of significant figures.

- | | | | |
|-------------------------|-------|----------------------------|-------|
| a) 6125×384 | ..... | d) $7550 \div 25$ | ..... |
| b) 25.00×0.010 | ..... | e) 0.000152×13.00 | ..... |
| c) $13.5 + 0.18$ | ..... | f) 0.0125×0.025 | ..... |

3) Write the following numbers in non standard form.

- | | | | |
|-------------------------|-------|--------------------------|-------|
| a) 1.5×10^{-3} | ..... | d) 5.34×10^2 | ..... |
| b) 4.6×10^{-4} | ..... | e) 1.03×10^6 | ..... |
| c) 3.575×10^5 | ..... | f) 8.35×10^{-3} | ..... |

4) Write the following numbers in standard form.

- | | | | |
|----------------|-------|-------------|-------|
| a) 0.000167 | ..... | d) 34500 | ..... |
| b) 0.0524 | ..... | e) 0.62 | ..... |
| c) 0.000000015 | ..... | f) 87000000 | ..... |

5) Complete the following calculations and give the answers to the appropriate number of significant figures.

- | | |
|--|-------|
| a) $6.125 \times 10^{-3} \times 3.5$ | ..... |
| b) $4.3 \times 10^{-4} \div 7.00$ | ..... |
| c) $4.0 \times 10^8 + 35000$ | ..... |
| d) $0.00156 + 2.4 \times 10^3$ | ..... |
| e) $6.10 \times 10^{-2} - 3.4 \times 10^{-5}$ | ..... |
| f) $8.00 \times 10^{-3} \times 0.100 \times 10^{-3}$ | ..... |

The Mole and Avogadro Constant

- One mole of anything contains 6.02×10^{23} of those things. One mole of bananas is 6.02×10^{23} bananas. One mole of water molecules is 6.02×10^{23} water molecules
- This number is known as the Avogadro constant ($= 6.02 \times 10^{23} \text{ mol}^{-1}$).
- The Avogadro number was chosen so that the mass of one mole of particles of a substance equals the M_r in grams. For example, the M_r of water is 18.0, and the mass of one mole of water molecules is 18.0 grams.



$$\text{Moles} = \frac{\text{Mass (in grams)}}{M_r}$$

$$1 \text{ ton} = 1,000,000 \text{ g}$$

$$1 \text{ kg} = 1,000 \text{ g}$$

$$1 \text{ mg} = 0.001 \text{ g}$$



Remember *Mr Moles!*

TASK 8 – MOLES

- 1) How many moles are there in each of the following?
 - a) 72.0 g of Mg
 - b) 4.00 kg of CuO
 - c) 39.0 g of $\text{Al}(\text{OH})_3$
 - d) 1.00 tonne of NaCl
 - e) 20.0 mg of $\text{Cu}(\text{NO}_3)_2$
- 2) What is the mass of each of the following?
 - a) 5.00 moles of Cl_2
 - b) 0.200 moles of Al_2O_3
 - c) 0.0100 moles of Ag
 - d) 0.00200 moles of $(\text{NH}_4)_2\text{SO}_4$
 - e) 0.300 moles of $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
- 3)
 - a) Calculate the number of moles of CO_2 molecules in 11.0 g of carbon dioxide.
 - b) Calculate the number of moles of C atoms in 11.0 g of carbon dioxide.
 - a) Calculate the number of moles of O atoms in 11.0 g of carbon dioxide.
- 4)
 - a) Calculate the number of moles of Al_2O_3 in 5.10 g of Al_2O_3 .
 - b) Calculate the number of moles of Al^{3+} ions in 5.10 g of Al_2O_3 .
 - a) Calculate the number of moles of O^{2-} ions in 5.10 g of Al_2O_3 .
- 5) An experiment was carried out to find the M_r of vitamin C (ascorbic acid). It was found that 1.00 g contains 0.00568 moles of Vitamin C molecules. Calculate the M_r of vitamin C.
- 6) Use the following data to calculate the mass of the particles shown.

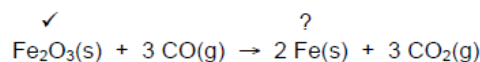
Mass of proton = $1.6726 \times 10^{-24} \text{ g}$	Mass of electron = $9.1094 \times 10^{-28} \text{ g}$
Mass of neutron = $1.6749 \times 10^{-24} \text{ g}$	Avogadro constant = $6.022 \times 10^{23} \text{ mol}^{-1}$

 - a) Calculate the mass of a ^1H atom.
 - b) Calculate the mass of an $^1\text{H}^+$ ion.
 - c) Calculate the mass of one mole of ^3H atoms.

Reacting Mass

- You can use balanced chemical equations to find out what mass of chemicals (or volume of gases) react or are produced in a chemical reaction. To do this, calculate:
(a) moles of ✓ (b) moles of ? (c) mass of ?

e.g. What mass of iron is produced when 32.0 kg of iron (III) oxide is heated with CO?



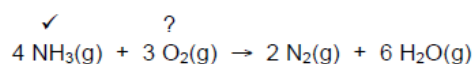
$$\text{moles of Fe}_2\text{O}_3 = \frac{\text{mass (g)}}{M_r} = \frac{32,000}{159.6} = 200.5 \text{ mol}$$

1 mole of Fe₂O₃ forms 2 moles of Fe

$$\therefore \text{moles of Fe} = 2 \times 200.5 = 401.0 \text{ mol}$$

$$\therefore \text{mass of Fe} = \text{moles} \times M_r = 401.0 \times 55.8 = \mathbf{22,400 \text{ g (3 sig fig)}}$$

e.g. What mass of oxygen is needed to convert 102 g of ammonia into nitrogen?



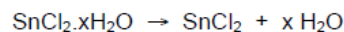
$$\text{moles of NH}_3 = \frac{\text{mass (g)}}{M_r} = \frac{102}{17.0} = 6.00 \text{ mol}$$

4 moles of NH₃ reacts with 3 moles of O₂ ∴ 1 mole of NH₃ reacts with $\frac{3}{4}$ mole of O₂

$$\therefore \text{moles of O}_2 = 6.00 \times \frac{3}{4} = 4.50 \text{ mol}$$

$$\therefore \text{mass of O}_2 = \text{moles} \times M_r = 4.50 \times 32.0 = \mathbf{144 \text{ g (3 sig fig)}}$$

e.g. When 5.00 g of crystals of hydrated tin (II) chloride, SnCl₂·xH₂O, are heated, 4.20 g of anhydrous tin (II) chloride are formed. Calculate the number of molecules of water of crystallisation are in SnCl₂·xH₂O (i.e. the value of x).



$$\text{moles of SnCl}_2 = \frac{\text{mass (g)}}{M_r} = \frac{4.20}{189.7} = 0.02214 \text{ moles}$$

$$\therefore \text{moles of SnCl}_2 \cdot x\text{H}_2\text{O} = 0.02214 \text{ mol}$$

$$\therefore M_r \text{ of SnCl}_2 \cdot x\text{H}_2\text{O} = \frac{\text{mass}}{\text{moles}} = \frac{5.00}{0.02214} = 225.8$$

$$\therefore M_r \text{ of } x\text{H}_2\text{O} = 225.8 - 189.7 = 36.1$$

$$\therefore x = \frac{36.1}{18.0} = \mathbf{2} \quad (\text{x is a whole number and so the final answer is given as an integer})$$

TASK 10 – REACTING MASS CALCULATIONS 1

- 1) What mass of hydrogen is needed to react with 40.0 g of copper oxide?
 $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$
- 2) What mass of oxygen reacts with 192 g of magnesium?
 $2 \text{Mg} + \text{O}_2 \rightarrow 2 \text{MgO}$
- 3) What mass of sulfur trioxide is formed from 96.0 g of sulfur dioxide?
 $2 \text{SO}_2 + \text{O}_2 \rightarrow 2 \text{SO}_3$
- 4) What mass of carbon monoxide is needed to react with 480 kg of iron oxide?
 $\text{Fe}_2\text{O}_3 + 3 \text{CO} \rightarrow 2 \text{Fe} + 3 \text{CO}_2$
- 5) What mass of carbon dioxide is produced when 5.60 g of butene is burnt.
 $\text{C}_4\text{H}_8 + 6 \text{O}_2 \rightarrow 4 \text{CO}_2 + 4 \text{H}_2\text{O}$
- 6) What mass of oxygen is needed to react with 8.50 g of hydrogen sulphide (H_2S)?
 $2 \text{H}_2\text{S} + 3 \text{O}_2 \rightarrow 2 \text{SO}_2 + 2 \text{H}_2\text{O}$
- 7) 4.92 g of hydrated magnesium sulphate crystals ($\text{MgSO}_4 \cdot n\text{H}_2\text{O}$) gave 2.40 g of anhydrous magnesium sulphate on heating to constant mass. Work out the formula mass of the hydrated magnesium sulphate and so the value of n .
 $\text{MgSO}_4 \cdot n\text{H}_2\text{O} \rightarrow \text{MgSO}_4 + n \text{H}_2\text{O}$
- 8) In an experiment to find the value of x in the compound $\text{MgBr}_2 \cdot x\text{H}_2\text{O}$, 7.30 g of the compound on heating to constant mass gave 4.60 g of the anhydrous salt MgBr_2 . Find the value of x .
 $\text{MgBr}_2 \cdot x\text{H}_2\text{O} \rightarrow \text{MgBr}_2 + x \text{H}_2\text{O}$
- 9) What mass of glucose must be fermented to give 5.00 kg of ethanol?
 $\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2 \text{C}_2\text{H}_5\text{OH} + 2 \text{CO}_2$
- 10) The pollutant sulfur dioxide can be removed from the air by reaction with calcium carbonate in the presence of oxygen. What mass of calcium carbonate is needed to remove 1.000 ton of sulfur dioxide?
 $2 \text{CaCO}_3 + 2 \text{SO}_2 + \text{O}_2 \rightarrow 2 \text{CaSO}_4 + 2 \text{CO}_2$

Task 11 Atomic Structure

1 This question is about the structure of atoms.

a Name the three particles that are found inside atoms.

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b Which of these particles are found inside the nucleus of the atom.

.....

c Which of these particles is neutral?

d Which of these particles has a negative electric charge?

e Which of these particles has a positive electric charge?

2 This question is about ${}_{13}^{27}\text{Al}$ atoms.

a How many protons, neutrons and electrons are in this atom?

protons = neutrons = electrons =

b What is it that makes this an atom of aluminium?

.....

3 Geiger and Marsden carried out an experiment where they fired alpha particles at a thin piece of gold. A small number of alpha particles were deflected or bounced back. This experiment led to Rutherford developing a new model of the atom.

a Why do most of the alpha particles pass straight through the gold atoms?

.....

.....

b Why do some of the alpha particles deflect or bounce back?

.....

.....

c Give two key differences between Rutherford's model of the atom and the Thomson's plum pudding model that it replaced.

1.....

2.....

4 a Define the term atomic number.

b Define the term mass number.

Task 12 Atomic Structure

1 Complete the following table about some atoms and ions.

Particle	Atom or ion	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electron structure
${}_{13}^{27}\text{Al}^{3+}$							
${}_{6}^{14}\text{C}$							
${}_{15}^{31}\text{P}^{3-}$							
				8	10	10	

2 The element indium consists of two isotopes, with 4.3% of the atoms are ${}_{49}^{113}\text{In}$ and 95.7% of the atoms are ${}_{49}^{115}\text{In}$.

a) What are isotopes?

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b) Calculate the relative atomic mass of indium. Give your answer to 4 significant figures.

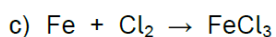
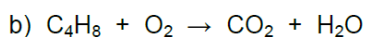
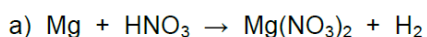
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3 Give the formula and structure type of each of the following substances. Tick the correct box.

name	lithium oxide	argon	ammonia	silver(I) nitrate	buckminsterfullerene	diamond
formula						
giant covalent						
ionic						
metallic						
molecular						
monatomic						

4 Balance these equations



5 Give the formula of the following ionic substances.

a) iron(III) oxide

c) aluminium nitrate

b) potassium sulfate

d) barium hydroxide

6 Sodium chloride has a high melting point (801 °C) while water has a low melting point (0 °C). Explain this difference.

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.....

7 Aluminium conducts electricity as a solid and when molten. Aluminium oxide does not conduct electricity as a solid but does when molten. Explain this difference.

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.....
.....

8 Nickel reacts with copper(II) sulfate to form copper: $\text{Ni} + \text{CuSO}_4 \rightarrow \text{NiSO}_4 + \text{Cu}$

a) Write two half equations for this reaction.

.....
.....

b) Write an ionic equation for this reaction.

.....

c) Explain clearly why this is a redox reaction.

.....
.....
.....
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d) Nickel displaces copper in this reaction because it is more reactive than copper. Explain, in terms of electrons, why nickel is more reactive than copper.

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Task 13 - Structure and Bonding

1 Give the formula of the following ionic compounds.

potassium carbonate aluminium hydroxide

calcium nitrate sodium bromide

2 Identify the structure type of the following substances.

name	silver nitrate	silicon oxide	helium	ammonia	copper	buckminsterfullerene	graphene	sucrose
formula	AgNO ₃	SiO ₂	He	NH ₃	Cu	C ₆₀	C	C ₁₂ H ₂₂ O ₁₁
giant covalent								
ionic								
metallic								
molecular								
monatomic								

3 This question is about some different forms (allotropes) of the element carbon.

	melting point (°C)	boiling point (°C)	electrical conductivity as		structure type				
			solid	liquid	giant covalent	ionic	metallic	molecular	monatomic
A	583	861	does not conduct	conducts					
B	-35	12	does not conduct	does not conduct					
C	1538	2862	conducts	conducts					
D	1414	3265	does not conduct	does not conduct					
E	44	280	does not conduct	does not conduct					
F	-248	-246	does not conduct	does not conduct					

Task 14 – Organic

1 Complete this table with the names and structures of some alkanes.

Displayed formula	$ \begin{array}{c} \text{H} \quad \text{H} \\ | \quad | \\ \text{H}-\text{C}-\text{C}-\text{H} \\ | \quad | \\ \text{H} \quad \text{H} \end{array} $		$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ | \quad | \quad | \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ | \quad | \quad | \\ \text{H} \quad \text{H} \quad \text{H} \end{array} $
Name		butane	

2 Define the following terms.

a hydrocarbon

.....

b saturated

.....

3 Hexane is an alkane containing 6 carbon atoms. Give its molecular formula.

4 Complete the table (using a ✓ in the relevant boxes) to compare two alkanes.

	most flammable	highest boiling point	most viscous	burns with cleanest flame
pentane (C ₅ H ₁₂)				
octane (C ₈ H ₁₈)				

5 a Write a balanced equation for the complete combustion of pentane (C₅H₁₂).

.....

b Write a balanced equation for the incomplete combustion of pentane (C₅H₁₂) to form carbon monoxide.

.....

Task 15 – Organic

- 1 Draw the displayed structure of each of the following molecules in the boxes.

propene	propane
ethanol	ethanoic acid

- 2 Butene is an alkene containing four C atoms.

a) What is the molecular formula of butene?

b) Butene is unsaturated. Explain the term unsaturated in this context.

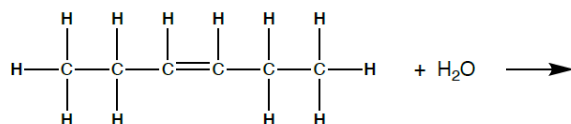
.....
.....

c) Describe a test what you could use to show that butene is unsaturated. Give the result.

test

result

d) Hexene is an alkene. Complete this equation to show how hexene reacts with steam to form an alcohol.

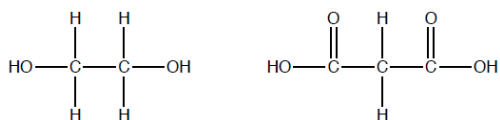


e) Describe a test what you could use to show that the product of reaction (d) is an alcohol. Give the result.

test

result

3 a) Draw the repeating unit of the condensation polymer formed from these monomers.



b) What type of condensation polymer is formed in (a)?

4 Name the monomer(s) in these polymers.

a) DNA.

b) proteins

c) poly(ethene)

d) cellulose

e) starch

5 Ethanoic acid is a weak acid. Hydrochloric acid is a strong acid. Complete this table about them.

	Ethanoic acid	Hydrochloric acid
colour with litmus indicator		
colour with universal indicator		
observation on reaction with magnesium		
observation on reaction with sodium carbonate		

6 Give three uses of the alcohol ethanol.

1

2

3

Answers

TASK 1 – Writing formulas of ionic compounds

1	AgBr	2	Na ₂ CO ₃	3	K ₂ O	4	Fe ₂ O ₃	5	CrCl ₃	6	Ca(OH) ₂
7	Al(NO ₃) ₃	8	Na ₂ SO ₄	9	PbO	10	Na ₃ PO ₄	11	Zn(HCO ₃) ₂	12	(NH ₄) ₂ SO ₄
13	Ga(OH) ₃	14	SrSe	15	RaSO ₄	16	Na ₃ N				

TASK 2 – Writing formulas 1

1	PbO ₂	2	Cu	3	Na	4	NH ₄ Cl	5	NH ₃	6	S ₈
7	H ₂ SO ₄	8	Ne	9	SiO ₂	10	Si	11	Ba(OH) ₂	12	SnCl ₄
13	AgNO ₃	14	I ₂	15	Ni	16	H ₂ S	17	TiO ₂	18	Pb
19	SrSO ₄	20	Li								

TASK 3 – Writing formulas 2

1	Ag ₂ CO ₃	2	Au	3	PtF ₂	4	HNO ₃	5	NH ₃	6	SiH ₄
7	P ₄	8	C	9	V ₂ O ₅	10	Co(OH) ₂	11	Ba(OH) ₂	12	NH ₃
13	HCl	14	F ₂	15	Si	16	Ca ₃ (PO ₄) ₂	17	Rb	18	GeO ₂
19	MgAt ₂	20	NO								

TASK 4 – Writing balanced equations 1

- $\text{Mg} + 2 \text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2$
 - $\text{CuCl}_2 + 2 \text{NaOH} \rightarrow \text{Cu}(\text{OH})_2 + 2 \text{NaCl}$
 - $2 \text{SO}_2 + \text{O}_2 \rightarrow 2 \text{SO}_3$
 - $\text{C}_4\text{H}_{10} + 6\frac{1}{2} \text{O}_2 \rightarrow 4 \text{CO}_2 + 5 \text{H}_2\text{O}$ or $2 \text{C}_4\text{H}_{10} + 13 \text{O}_2 \rightarrow 8 \text{CO}_2 + 10 \text{H}_2\text{O}$
- $4 \text{Na} + \text{O}_2 \rightarrow 2 \text{Na}_2\text{O}$
 - $2 \text{Al} + 3 \text{Cl}_2 \rightarrow 2 \text{AlCl}_3$
 - $\text{Ca} + 2 \text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2$
 - $2 \text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4$

TASK 7 – Significant figures & standard form

1	a 345800	b 297000	c 0.0790	d 6.10	e 0.00156	f 0.01040
2	a 2350000 (3sf)	b 0.25 (2sf)	c 13.7	d 300 (2sf)	e 0.00198 (3sf)	f 0.00031 (2sf)
3	a 0.0015	b 0.00046	c 357500	d 534	e 1030000	f 0.00835
4	a 1.64×10^{-4}	b 5.24×10^{-2}	c 1.5×10^{-8}	d 3.45×10^4	e 6.2×10^{-1}	f 8.7×10^7
5	a 0.021 (2sf)	b 6.1×10^{-5} (2sf)	c 4.0×10^8	d 2400	e 0.0610	f 8.00×10^{-7} (3sf)

TASK 8 – Moles

1	a 2.96	b 50.3	c 0.500	d 17100	e 0.000107
2	a 355 g	b 20.4 g	c 1.08 g	d 0.264 g	e 85.8 g
3	a 0.250	b 0.250	c 0.500		
4	a 0.0500	b 0.100	c 0.150		
5	176				
6	a 1.6735×10^{-24} g	b 1.6726×10^{-24} g	c 3.025 g		

TASK 10 – Reacting mass calculations 1

1	1.01 g	2	126 g	3	120 g	4	253000 g	5	17.6 g	6	12.0 g
7	7	8	6	9	9780 g	10	1560000 g				

Task 11 Atomic Structure

- 1 This question is about the structure of atoms.
- Name the three particles that are found inside atoms. **protons, neutrons, electrons**
 - Which of these particles are found inside the nucleus of the atom. **protons, neutrons**
 - Which of these particles is neutral? **neutrons**
 - Which of these particles has a negative electric charge? **electrons**
 - Which of these particles has a positive electric charge? **protons**
- 2 This question is about ${}_{13}^{27}\text{Al}$ atoms.
- How many protons, neutrons and electrons are in this atom?
protons = **13** neutrons = **14** electrons = **13**
 - What is it that makes this an atom of aluminium? **it has 13 protons**
- 3 Geiger and Marsden carried out an experiment where they fired alpha particles at a thin piece of gold. A small number of alpha particles were deflected or bounced back. This experiment led to Rutherford developing a new model of the atom.
- Why do most of the alpha particles pass straight through the gold atoms?
most of the atom is empty space
 - Why do some of the alpha particles deflect or bounce back?
they hit or pass close to the nucleus
 - Give two key differences between Rutherford's model of the atom and the Thomson's plum pudding model that it replaced.
 - in Rutherford's model there is a small, central, positive nucleus**
 - in Rutherford's model the electrons are outside the nucleus**
 - in Rutherford's model there most of the atom is empty space**
- 4
- Define the term atomic number. **number of protons**
 - Define the term mass number. **number of protons + neutrons**

Task 12 Atomic Structure

1 Complete the following table about some atoms and ions.

Particle	Atom or ion	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electron structure
${}_{13}^{27}\text{Al}^{3+}$	ion	13	27	13	14	10	2,8
${}_{6}^{14}\text{C}$	atom	6	14	6	8	6	2,4
${}_{15}^{31}\text{P}^{3-}$	ion	15	31	15	16	18	2,8,8
${}_{8}^{18}\text{O}^{2-}$	ion	8	18	8	10	10	2,8

2 The element indium consists of two isotopes, with 4.3% of the atoms are ${}_{49}^{113}\text{In}$ and 95.7% of the atoms are ${}_{49}^{115}\text{In}$.

- a) What are isotopes? **Atoms with the same number of protons but a different number of neutrons**
- b) Calculate the relative atomic mass of indium. Give your answer to 4 significant figures.

$$\frac{[4.3 \times 113] + [95.7 \times 115]}{4.3 + 95.7} = 114.9$$

3 Give the formula and structure type of each of the following substances. Tick the correct box.

name	lithium oxide	argon	ammonia	silver(I) nitrate	buckminsterfullerene	diamond
formula	Li₂O	Ar	NH₃	AgNO₃	C₆₀	C
giant covalent						✓
ionic	✓			✓		
metallic						
molecular			✓		✓	
monatomic		✓				

4 Balance these equations

- a) $\text{Mg} + 2\text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2$
- b) $\text{C}_4\text{H}_8 + 6\text{O}_2 \rightarrow 4\text{CO}_2 + 4\text{H}_2\text{O}$
- c) $2\text{Fe} + 3\text{Cl}_2 \rightarrow 2\text{FeCl}_3$

5 Give the formula of the following ionic substances.

- a) iron(III) oxide **Fe₂O₃** c) aluminium nitrate **Al(NO₃)₃**
b) potassium sulfate **K₂SO₄** d) barium hydroxide **Ba(OH)₂**

6 Sodium chloride has a high melting point (801 °C) while water has a low melting point (0 °C). Explain this difference.

NaCl: strong attraction between positive and negative ions

ice: weak forces between molecules

7 Aluminium conducts electricity as a solid and when molten. Aluminium oxide does not conduct electricity as a solid but does when molten. Explain this difference.

Al: delocalised electrons can move to carry charge as solid and liquid

Al₂O₃: ions cannot move as solid but can move as liquid to carry the charge

8 Nickel reacts with copper(II) sulfate to form copper: $\text{Ni} + \text{CuSO}_4 \rightarrow \text{NiSO}_4 + \text{Cu}$

a) Write two half equations for this reaction.



b) Write an ionic equation for this reaction.



c) Explain clearly why this is a redox reaction.

both oxidation and reduction take place

Ni atoms lose electrons so oxidised, Cu²⁺ ions gain electrons so reduced

d) Nickel displaces copper in this reaction because it is more reactive than copper. Explain, in terms of electrons, why nickel is more reactive than copper.

nickel atoms lose electrons more easily than copper atoms

Task 13 - Structure and Bonding

1 Give the formula of the following ionic compounds.

potassium carbonate K_2CO_3

aluminium hydroxide $Al(OH)_3$

calcium nitrate $Ca(NO_3)_2$

sodium bromide $NaBr$

2 Identify the structure type of the following substances.

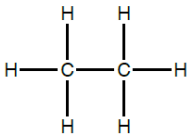
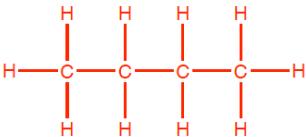
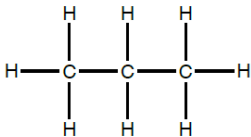
name	silver nitrate	silicon oxide	helium	ammonia	copper	buckminster fullerene	graphene	sucrose
formula	AgNO ₃	SiO ₂	He	NH ₃	Cu	C ₆₀	C	C ₁₂ H ₂₂ O ₁₁
giant covalent		✓					✓	
ionic	✓							
metallic					✓			
molecular				✓		✓		✓
monatomic			✓					

3 This question is about some different forms (allotropes) of the element carbon.

	melting point (°C)	boiling point (°C)	electrical conductivity as		structure type				
			solid	liquid	giant covalent	ionic	metallic	molecular	monatomic
A	583	861	does not conduct	conducts		✓			
B	-35	12	does not conduct	does not conduct				✓	
C	1538	2862	conducts	conducts			✓		
D	1414	3265	does not conduct	does not conduct	✓				
E	44	280	does not conduct	does not conduct				✓	
F	-248	-246	does not conduct	does not conduct					✓

Task 14 – Organic

1 Complete this table with the names and structures of some alkanes.

Displayed formula			
Name	ethane	butane	propane

2 Define the following terms.

a hydrocarbon **compound containing hydrogen and carbon only**

b saturated **contains no double bond(s)**

3 Hexane is an alkane containing 6 carbon atoms. Give its molecular formula. **C₆H₁₄**

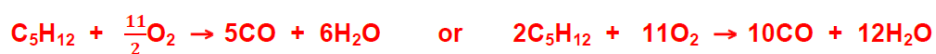
4 Complete the table (using a ✓ in the relevant boxes) to compare two alkanes.

	most flammable	highest boiling point	most viscous	burns with cleanest flame
pentane (C ₅ H ₁₂)	✓			✓
octane (C ₈ H ₁₈)		✓	✓	

5 a Write a balanced equation for the complete combustion of pentane (C₅H₁₂).

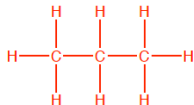
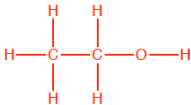


b Write a balanced equation for the incomplete combustion of pentane (C₅H₁₂) to form carbon monoxide.



Task 15 – Organic

- 1 Draw the displayed structure of each of the following molecules in the boxes.

<p>propene</p> 	<p>propane</p> 
<p>ethanol</p> 	<p>ethanoic acid</p> 

- 2 Butene is an alkene containing four C atoms.

a) What is the molecular formula of butene? **C₄H₈**

b) Butene is unsaturated. Explain the term unsaturated in this context.

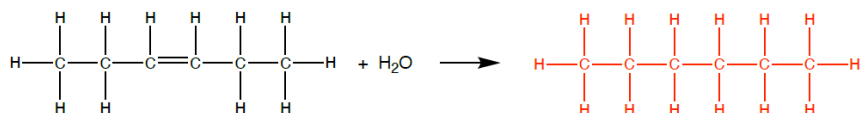
contains double bond(s)

c) Describe a test what you could use to show that butene is unsaturated. Give the result.

test **add bromine water**

result **goes from orange to colourless**

d) Hexene is an alkene. Complete this equation to show how hexene reacts with steam to form an alcohol.

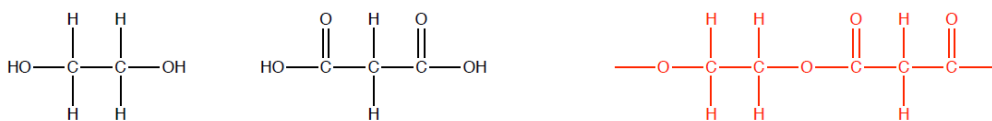


e) Describe a test what you could use to show that the product of reaction (d) is an alcohol. Give the result.

test **add sodium**

result **fizzes**

- 3 a) Draw the repeating unit of the condensation polymer formed from these monomers.



- b) What type of condensation polymer is formed in (a)? **polyester**

- 4 Name the monomer(s) in these polymers.

- a) DNA **nucleotides**
 b) proteins **amino acids**
 c) poly(ethene) **ethene**
 d) cellulose **glucose**
 e) starch **glucose**

- 5 Ethanoic acid is a weak acid. Hydrochloric acid is a strong acid. Complete this table about them.

	Ethanoic acid	Hydrochloric acid
colour with litmus indicator	red	red
colour with universal indicator	orange	red
observation on reaction with magnesium	slow bubbles	fast bubbles
observation on reaction with sodium carbonate	slow bubbles	fast bubbles

- 6 Give three uses of the alcohol ethanol.

- 1 **as a fuel**
- 2 **as a solvent**
- 3 **in alcoholic drinks**

GCSE → A Level transition test

Circle the correct answers in this section

1 Which row shows the atomic structure of an atom of the ^{19}F 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 $^{56}\text{Fe}^{3+}$ 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 $\text{Ca}(\text{OH})_2$

[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]

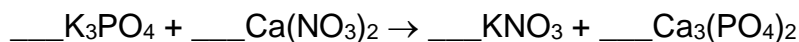
7 Lithium reacts with oxygen to form lithium oxide, Li_2O

Which equation is correct for this reaction?

- A $\text{Li} + \text{O}_2 \rightarrow \text{Li}_2\text{O}$
B $\text{Li} + \text{O}_2 \rightarrow \text{LiO}_2$
C $2\text{Li} + \text{O}_2 \rightarrow \text{Li}_2\text{O}_2$
D $4\text{Li} + \text{O}_2 \rightarrow 2\text{Li}_2\text{O}$

[1]

8 Balance the equation below.



[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]

Tick the boxes next to the correct answers in this section

11 Sodium carbonate contains sodium ions and carbonate ions.

Which statement(s) is/are correct?

The formula of sodium carbonate is NaCO_3 .

The relative formula mass of sodium carbonate is 106.

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

A sodium ion contains one electron in its outer shell.

[1]

12 A sample of copper contains two isotopes, ^{63}Cu and ^{65}Cu . The relative atomic mass of copper is 63.5.

Which statement(s) is/are correct? Tick **two** boxes

^{65}Cu has two more neutrons than ^{63}Cu

^{65}Cu has two more protons than ^{63}Cu

^{63}Cu and ^{65}Cu contain the same number of electrons

^{65}Cu has two more electrons than ^{63}Cu

[1]

14 Which statement describes the structure of an atom?

a sphere of positive charge with electrons embedded in it

a nucleus containing protons and neutrons, orbited by electrons

a solid sphere that cannot be divided into smaller parts

protons and electrons concentrated in a nucleus, surrounded by orbiting neutrons

[1]

15 Which force holds an atom's nucleus together?

electrostatic force

electromagnetic force

strong nuclear force

weak intermolecular interactions

[1]

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

measurement error

systematic error

random error

zero error

[1]

Answer the questions in the spaces provided in this section

17 Describe what it means when results are described as:

accurate:

.....

precise:

..... [2]

18 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	.....
.....	34	.....	.....	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.

.....

.....

.....

.....

.....