GET READY TO STUDY A LEVEL CHEMISTRY

Welcome! If you are planning to study A Level chemistry with us in September, please review this document and complete the required 'Induction Task' activities section.

You are required to bring the completed 'Induction Task' section with you at induction.

Please be aware that you will have to sit an assessment on the knowledge and skills covered here within the first two weeks of the course. There will be an opportunity to review your Induction Task and answer any questions you may have in one of the lessons before you sit the assessment.

FAQ

What specification will I study?

You'll be covering the OCR A specification – you can find it here.

How many lessons will I have a week?

You'll have 4 lessons a week, two single lessons and a 'double' lesson.

Who can I contact if I have a question about this subject?

Alex Melhuish, Curriculum Leader for Science, a.melhuish@barnsley.ac.uk

John Pugh, Teacher of Chemistry, j.pugh@barnsley.ac.uk

What subjects go well with Chemistry?

It's a challenging science subject so we recommend you choose other STEM subjects such as biology, maths and physics to complete your study programme.

What grades should I have?

In addition to the general sixth form entry requirements, learners must have a 6 in chemistry and another science or 66 in combined science and 5 in maths

WHAT WILL I STUDY?

Practical skills (Module 1) are developed across 16 scheduled endorsed practical sessions, over two years, assessing your practical competencies. Practical theory can be examined across any of the three final exam papers (see table/link below).

In Year 1, you will study the following topics:

Foundation skills in chemistry (Module 2)

- Atoms, compounds, molecules and equations ▪ Amount of substance 2
- Acid–base and redox reactions ▪ Electrons, bonding and structure

Periodic table and energy (Module 3)

- The periodic table and periodicity ▪ Group 2 and the halogens
- Qualitative analysis ▪ Enthalpy changes
- Reaction rates and equilibrium (qualitative)

Core organic chemistry (Module 4)

- Basic concepts ▪ Hydrocarbons ▪ Alcohols and haloalkanes
- Organic synthesis ▪ Analytical techniques (IR and MS)

In Year 2, you will study the following topics:

Physical chemistry and transition elements (Module 5)

- Reaction rates and equilibrium (quantitative) ▪ pH and buffers
- Enthalpy, entropy and free energy ▪ Redox and electrode potentials
- Transition elements

Organic chemistry and analysis (Module 6)

- Aromatic compounds ▪ Carbonyl compounds ▪ Carboxylic acids and esters
- Nitrogen compounds ▪ Polymers ▪ Organic synthesis
- Chromatography and spectroscopy (NMR)

The modules assessed in the component, marks, duration, and weightings for all components are shown below:

Components	Modules	Marks	Duration	Weighting
Paper 1: Periodic table, elements and physical chemistry	1, 2, 3, 5	100	2 hours 15 minutes	37%
Paper 2: Synthesis and analytical techniques	1, 2, 4, 6	100	2 hours 15 minutes	37%
Paper 3: Unified chemistry	All	70	1 hour 30 minutes	26%
Practical Endorsement Non-exam assessment	1	Assessed internally through a minimum of 12 practical activities		Reported separately

https://www.ocr.org.uk/Images/assessment-story-exploring-our-question-papers-chemistrya.pdf

WHAT WILL I NEED?

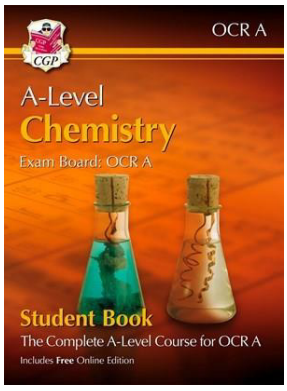
To study the course, you will need the following equipment:

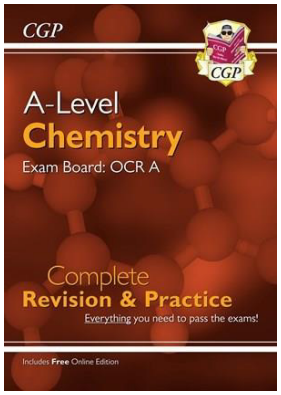
- A scientific calculator
- A folder with dividers 3
- Lined paper
- Pens (multiple colours) and pencils
- Highlighters 3 colours
- A ruler
- Whiteboard pens

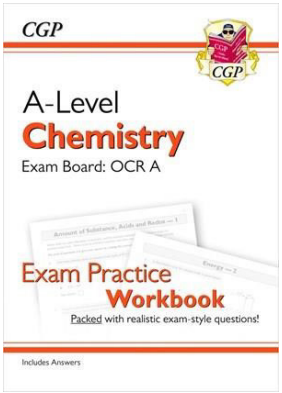
Students also find it useful to have:

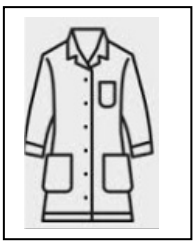
- Blank flashcards
- A whiteboard

We recommend all students buy a textbook, lab coat and safety glasses - see below (these resources are available to share with other students in class)









These can be purchased from the college at the start of term.
Financial support is available for these.

Recommended revision websites (Add to Favourites!)

OCR (A) A-level Chemistry Revision - PMT

Chemguide: helping you to understand Chemistry

FIND OUT MORE

These links are to help broaden your understanding of the subject in preparation for studying this subject at an advanced level.

Careers	Here are some useful links looking at careers in chemistry Career options in chemistry Prospects Explore careers | National Careers Service
Social Media	MaChemGuy on Twitter
YouTube	There are some really useful videos for the course so we recommend subscribing to the following channels: MaChemGuy (youtube channel) MaChemGuy (website) Allery Chemistry Royal Society of Chemistry
Further Reading / Useful websites	Keep up to date with the news and events in chemistry Chemistry world Royal Society of Chemistry New Scientist | Science news, articles, and features

REQUIRED ACTIVITIES

Choosing your A Levels can be a challenge for some learners therefore if you are undecided around which subjects you are planning to study completing these activities will give yourself greater insight into the course to help ensure you have made the right choice.

It is important that all the required activities are completed in preparation for starting your course.

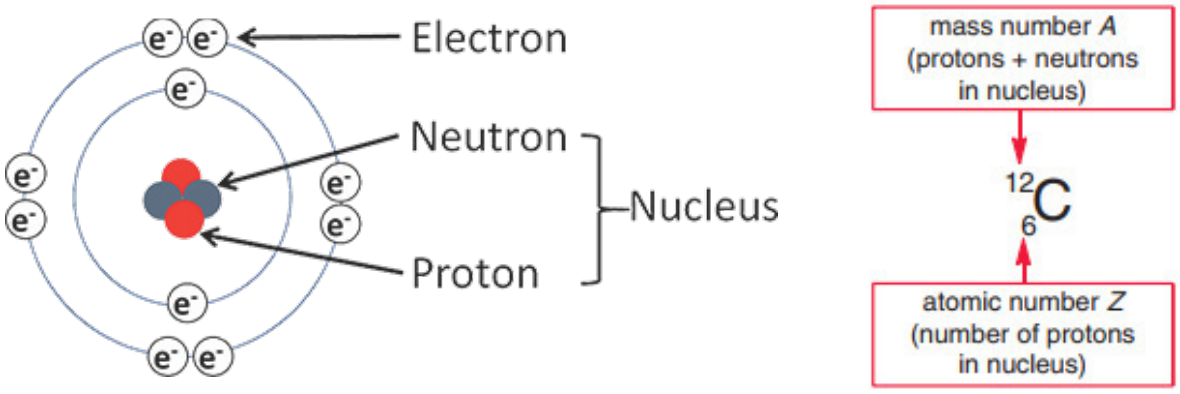
Read through the information on pages 5-13, one section at a time. You may want to use the embedded hyperlinks to further review content. Once you have reviewed, complete the corresponding tasks, indicated in **bold** on each page.

When completed, you should have attempted all of the questions from pages 14-17, this is your Induction Task.

Please bring the last four pages of the booklet titled "Induction Task" with you at induction. This section will be marked and returned to you.

Atomic structure

Revise atomic structure – make sure you can describe the structure of an atom and link the sub-atomic particles to the numbers on a periodic table. (remember, atomic (proton) number identifies the element and is the smaller of the two numbers.



This video will help you recap.

Have a go at completing questions 1 and 2 in the Induction Task section.

Relative Atomic Mass Calculations

Revise relative atomic mass calculations – this video will help you recap.

$$Ar = \frac{(\text{relative abu isotope 1} \times \text{mass number}) + (\text{relative abu isotope 2} \times \text{mass number})}{\text{Total abundance}}$$

Example 1:

Gallium is a mixture of two isotopes with mass numbers 69 and an abundance of 60.2% and mass number 71 and an abundance of 39.8%. Calculate the relative atomic mass to 1 d.p.

$$A_r = \frac{(69 \times 60.2) + (71 \times 39.8)}{100} = 69.8$$

Example 2 (Algebraic problems):

A naturally occurring sample of the element boron has a relative atomic mass of 10.8. In this sample, boron exists as two isotopes, $_{10}B$ and $_{11}B$. Calculate the percentage abundance of $_{10}B$ in this naturally occurring sample of boron.

We do not know what the % of abundance of each isotope is so we will name these x and y. If the total abundance is 100% and we know x then y will equal 100 – x.

i If x = 90, y= 100 – 90 = 10. In terms of x and y this means y = 100-X

Substitute into the equation, multiply out brackets, rearrange and solve for X :

$$10.8 = \frac{(10 \times X) + (11 \times (100-X))}{100}$$

$$1080 = 10X + 1100 - 11X$$

$$1080 - 1100 = 10X - 11X$$

$$-20 = -X$$

Percentage abundance of $_{10}B$ = 20%

Have a go at completing question 3 in the Induction Task section.

Formulae

You need to know the formula and charge of common ions and compounds and how to combine the charges of ions to write formulae for ionic compounds. You will use the formulae for ionic compounds and covalent molecules to write balanced equations.

The next two pages includes some of the common ions and formulae you should know.

Ionic compounds

In an uncharged compound, the total number of + and – charges must be exactly the same. You can use as many of the + and – ions as necessary to work out the formula.

Magnesium sulfate : contains Mg^{2+} and SO_4^{2-}, the total number of + and – charges are equal therefore the formula will be $MgSO_4$.

Calcium hydroxide: contains Ca^{2+} and OH^- , the total number of + and – charges are not equal to make them equal you need an additional OH^- therefore the formula will be $Ca(OH)_2$

<u>Common Acids - you must learn!</u>

HCl	Hydrochloric Acid
HNO_3	Nitric Acid
H_2SO_4	Sulphuric Acid
H_3PO_4	Phosphoric Acid
CH_3COOH	Ethanoic Acid

Common Formulae covalent compounds:

Diatomics: H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2 Hydrogen, nitrogen, oxygen, fluorine, chlorine, bromine, iodine

Polyatomics: H_2O, CO_2, CO , NH_3 water, carbon dioxide, carbon monoxide, ammonia

Watch this video and complete the activities on the video.

Once you are confident at writing formula complete Q4 in the 'Induction Task' section.

Formulae of Ions

Positive Ions (Cations)

1+		2+		3+	
Hydrogen	H^+	Magnesium	Mg^{2+}	Aluminium	Al^{3+}
Lithium	Li^+	Calcium	Ca^{2+}	Iron(III)	Fe^{3+}
Sodium	Na^+	Barium	Ba^{2+}	Chromium (III)	Cr^{3+}
Potassium	K^+	Copper (II)	Cu^{2+}		
Caesium	Cs^+	Lead	Pb^{2+}		
Silver	Ag^+	Zinc	Zn^{2+}		
		Iron (II)	Fe^{2+}		
Ammonium	NH_4^+				

Where there are brackets with roman numerals, this corresponds to the charge on the ion.

Negative Ions (Anions)

-1		-2		-3	
Fluoride	F^-	Oxide	O^{2-}	Nitride	N^{3-}
Chloride	Cl^-	Sulphide	S^{2-}	Phosphide	P^{3-}
Bromide	Br^-				
Iodide	I^-				
Hydroxide	OH^-	Carbonate	CO_3^{2-}	Phosphate	PO_4^{3-}
Nitrate	NO_3^-	Sulphate	SO_4^{2-}		
Cyanide	CN^-				

Key tests for anions (order of tests Carbonate Sulfate, Halide - Ca$H)

1) CO_3^{2-}, reaction with H^+ (acid) forming CO_2(g) - fizzing.
2) SO_4^{2-}, precipitation with Ba^{2+} forming $BaSO_4$(s) . (Note **$BaCO_3$** also produces a precipitate)
3) Cl^-, Br^-, I^- precipitation with silver nitrate, making AgX (s): white, cream, yellow ppt, respectively.
4) AgCl(s) dissolves in dil. ammonia, AgBr(s) dissolves in conc ammonia. AgI(s) insoluble in ammonia (Note **Ag_2SO_4** also produces a precipitate)
5) NH_4^+, Warm with aqueous sodium hydroxide. Test ammonia gas formed with damp pH indicator paper (turns blue).

Balancing equations

At A-Level you need to: Identify products made, (so you need to know your general reactions, below). Work out formulae and write an equation . Balance the atoms (you can only change the big numbers in front of each reactant and product, not by changing the actual formula elements/compounds)

General reactions – **you must learn these!**	metal + water	⟶	metal hydroxide + hydrogen
	metal + acid	⟶	salt + hydrogen
	metal hydroxide + acid	⟶	salt + water
	metal oxide + acid	⟶	salt + water
	metal carbonate + acid	⟶	salt + water + carbon dioxide
	ammonia + acid	⟶	ammonium salt

The type of salt made depends on the acid used:

Acid	**salt**
• Hydrochloric acid	chloride
• Sulfuric acid	sulfate
• Nitric acid	nitrate
• Phosphoric acid	phosphate
• Ethanoic acid	ethanoate

Example:

Magnesium and nitric acid:

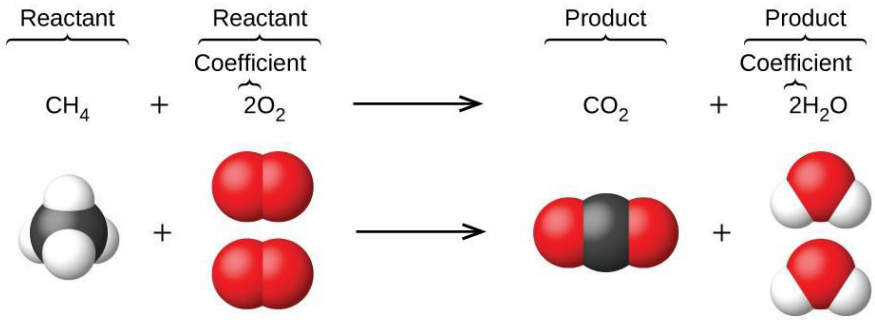
- Identify products made; Metal + acid form salt + hydrogen. **Nitric acid**, therefore a **nitrate** is formed
- Work out formulae and write out equation; Magnesium Mg reacts with Nitric acid HNO_3 to form Hydrogen H_2 and Magnesium Nitrate $Mg^{2+}NO_3^-$, for ionic salt - balancing charges makes $Mg(NO_3)_2$

$$Mg + HNO_3 \longrightarrow Mg(NO_3)_2 + H_2$$

- Once formulae established then balance the atoms – the big numbers in front of reactants and products (These are called molar coefficients, and balancing equations is called stoichiometry)

$$Mg + 2HNO_3 \longrightarrow Mg(NO_3)_2 + H_2$$

Next is and example of balancing for a covalent reaction, it can be useful to use displayed formulae to tally up the numbers of each atom type on either side of the reaction arrow.



Watch this video if you need help with balancing equations.

Have a go at completing Q5 & Q6 in the Induction Task section.

Moles Calculations and calculating reacting masses

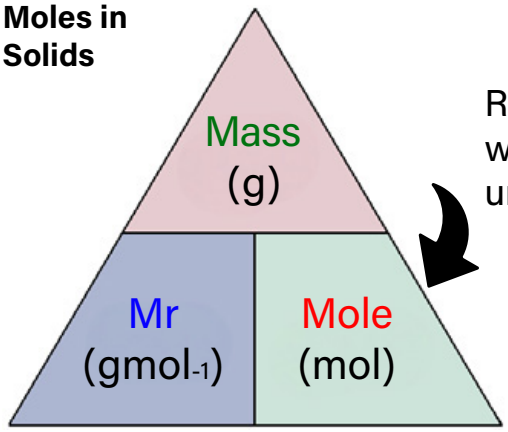
Calculating moles is an important skill in A level chemistry and it is vital that you are confident using moles equations. Watch this video and complete the activity.

Important equations involving moles

Number of particles = number of moles x Avogadro constant $N = n \times N_A$

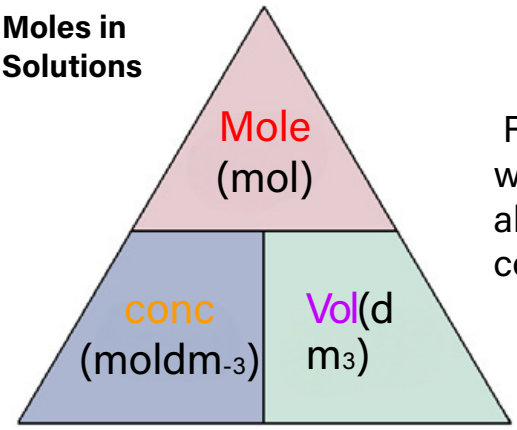
Avogadro constant Nis the number if particles in 1 mole of a substance = 6.022×10^{23} A

Moles in Solids



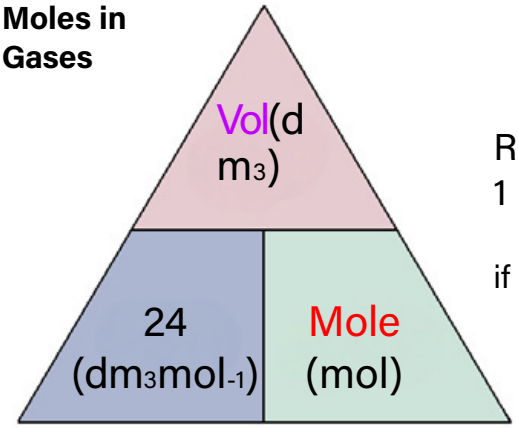
Remember,
where does Mr Mole live?
under(g)round (Mass in grams)

Moles in Solutions



Remember,
we fill this left to right alphabetically, c then m (or more correctly n) then V

Moles in Gases



Remember,
1 Mole of any gas will occupy 24 dm_3

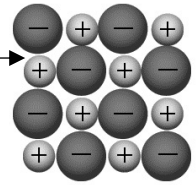
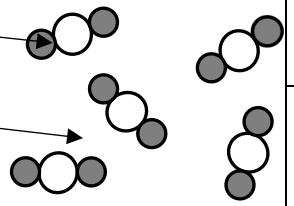
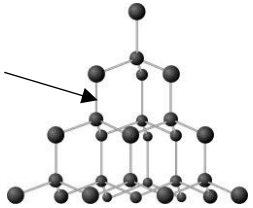
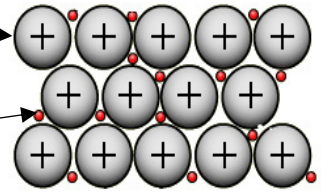
if using cm_3 then use 24,000 as 1000 cm_3 in 1 dm_3

Watch the video on calculating reacting mass completing the activities within the video.

Have a go at completing Q7 - 12 in the Induction Task section

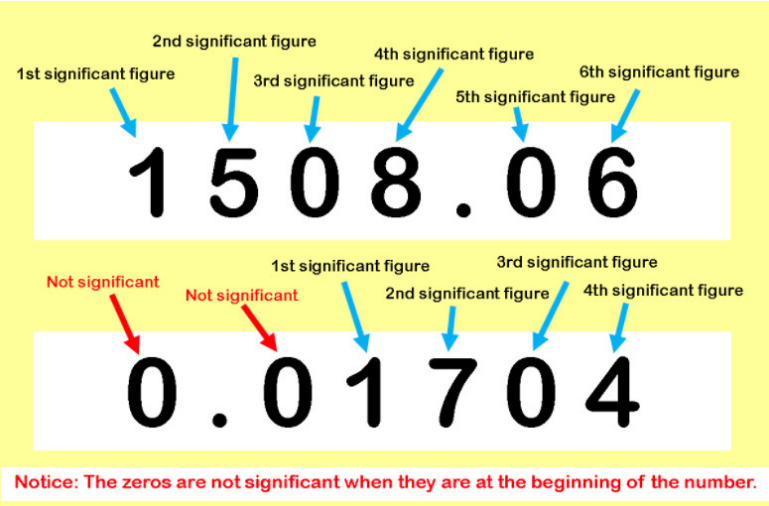
Structure and Bonding. Research the properties of the diff erent structures and give an explanation for these properties.

https://www.chemguide.co.uk/atoms/bondingmenu.html

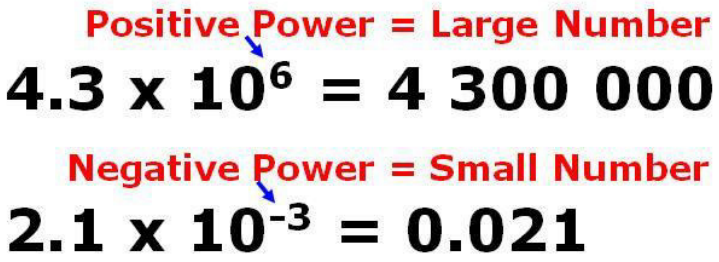
Structure	Properties	Explanation
Giant ionic structure *Lattice of positive and negative ions strongly attracted together* 	Melting point	
	Electrical conductivity	
Simple molecular structure *Strong covalent bonds* *Weak intermolecular forces* 	Melting point	
	Electrical conductivity	
Giant covalent structure *Strong covalent bonds* 	Melting point	
	Electrical conductivity	
Metallic structure *Positive ions* *Delocalised electrons from the outer shells of the metal atoms* 	Melting point	
	Electrical conductivity	

General math skills

Often questions ask for answers to be given to a certain number of significant figures



Or standard form



Converting units

Mass units		How to convert
1000 mg	1g	Divide by 1000
1000 g	1kg	Divide by 1000
1000 kg	1 tonne	Divide by 1000
Volume units		
1000 cm^3	1 dm^3	Divide by 1000
1000 dm^3	1 m^3	Divide by 1000
Temperature units		
0 °C	273 Kelvin	Add 273
Pressure units		
1000 Pa	1 kPa	Divide by 1000

Have a go at Q13 in the Induction Task section.

Basic Organic chemistry

Half of the course is dedicated to organic chemistry. You should have some knowledge from GCSE on alkanes, alkenes, alcohols, carboxylic acids and esters. These different molecules behave differently due to their functional groups. You will find a some introductory topics for organic compounds here:
https://www.chemguide.co.uk/basicorg/conventions/draw.html#top
https://www.chemguide.co.uk/basicorg/conventions/names.html#top

The Alkanes are an example of a **homologous series** 6 **Complete the list of names:**

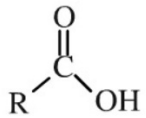
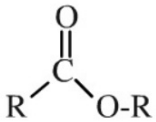
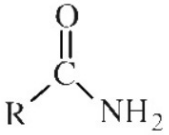
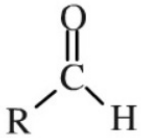
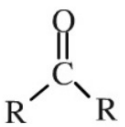
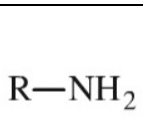
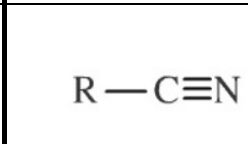
Molecular formula	Condensed Structural Formula	Name
CH_4	CH_4	**methane**
C_2H_6	CH_3CH_3	
C_3H_8	$CH_3CH_2CH_3$	
C_4H_{10}	$CH_3CH_2CH_2CH_3$	
C_5H_{12}	$CH_3CH_2CH_2CH_2CH_3$	
C_6H_{14}	$CH_3CH_2CH_2CH_2CH_2CH_3$	

What is the General Formula for alkanes? _____

Draw the displayed formula for propane:

Draw the skeletal formula for pentane:

Understanding functional groups are an important of organic chemistry. **Do some research to find out and name these common functional groups:**

Structure	Functional group	Structure	Functional group
		R–X X = F, Cl, Br, I	
			
			
			

INDUCTION TASK

Atomic Structure

Q1. Complete the table to show the location, relative charge and relative mass of each sub-atomic particle found within an atom

Sub-atomic particle	Location	Relative charge	Relative mass
Neutron			
Proton			
Electron			

(3 marks)

Q2. Complete the missing data in the table below :

Atom	Atomic Number	Mass Number	No. of protons	No. of electrons	No. of neutrons
N					
	5	11			
			18		22

(3 marks)

Q3. Calculate the relative atomic mass (RAM) of the following elements

a) Silicon contains: 92.18% $_{28}$Si, 4.70% $_{29}$Si & 3.12% $_{30}$Si Ar: _____

b) contains: 4.31% $_{50}$X, 83.76% $_{52}$X, 9.55% $_{53}$X & the rest of the sample is $_{54}$X (2 marks) Ar: _____ Use the periodic table to work out the identity of this unknown element: _____ (3 marks)

c) The element indium exists as a mixture of two isotopes of mass numbers 113 and 115. The RAM of indium = 114.82. Calculate the percentage abundance of the two isotopes

113 %_____ 115% _____ (3 marks)

Formula and equations

Q4. Complete the grid to give the correct formula

cation	chloride	sulfate	hydroxide	nitrate
sodium	NaCl	Na_2SO_4		$NaNO_3$
calcium		$CaSO_4$	$Ca(OH)_2$	
aluminium				$Al(NO_3)_3$
hydrogen		H_2SO_4		

(5 marks)

Q5. Balance the following equations:

1. $\ldots\ldots C + \ldots\ldots O_2 \longrightarrow \ldots\ldots CO$
2. $\ldots\ldots Ba + \ldots\ldots H_2O \longrightarrow \ldots\ldots Ba(OH)_2 + \ldots\ldots H_2$
3. $\ldots\ldots C_2H_6 + \ldots\ldots O_2 \longrightarrow \ldots\ldots CO_2 + \ldots\ldots H_2O$
4. $\ldots\ldots HCl + \ldots\ldots Mg(OH)_2 \longrightarrow \ldots\ldots MgCl_2 + H_2O$
5. $\ldots\ldots N_2 + \ldots\ldots O_2 \longrightarrow \ldots\ldots NO$

(5 marks)

Q6. Write balanced equations for each of these reactions from their description. Work out the formulae of the reactants and products first, then balance equations.

Hint: Common gases like nitrogen and oxygen are diatomic molecules (e.g. O_2).

The reaction between silicon and nitrogen to form silicon nitride Si_3N_4.

.....

The extraction of iron from iron(III) oxide (Fe_2O_3) using carbon monoxide.

.....

The preparation of boron trichloride from its elements.

.....

The reaction of nitrogen and oxygen to form nitrogen monoxide.

.....

The formation of silicon tetrachloride ($SiCl_4$) from SiO_2 using chlorine gas and carbon.

.....

(5 marks)

Mole calculations

Q7. Calculate the Mr of each compound listed below, showing full working:

a) $CaCO_3$
b) $Cu(OH)_2$
c) $(NH_4)_2SO_4$

(3 marks)

Q8. Calculate the number of moles in the following:

a) 90.0 g of H_2O .....

.....

b) 20.0 g of C_4H_{10} .....

.....

(2 marks)

Q9. Calculate the mass of the following:

a) 0.400 moles of C_2H_5OH .....

.....

b) 10.0 moles of $Ca(OH)_2$ .....

.....

(2 marks)

Q10. Calculate concentration (mol dm^{-3}) when 5.0 g of $NaHCO_3$ is dissolved in 100 cm^3 water. (2 marks)

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Q11. What mass of iron is formed when 240g of iron (III) oxide reacts with carbon monoxide

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

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(2 marks)

Q12. The equation for the reaction of G2 metal X reacts to make 138 cm^3 of hydrogen gas. Determine moles of H_2 and use this and the equation to identify metal X.

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(3 marks)

Q13.

a) Round the following number 304659 17

2 significant figures	3 significant figures	standard form (2d.p.)

(3 marks)

b) Round the following number 0.0005433894

2 significant figures	3 significant figures	standard form (2d.p.)

(3 marks)

c) Convert the following values

200 cm^3 into dm^3	
250 mg into g	
2 kg into g	
3000 kg into tonnes	
0.00680 g into mg	
500 cm^3 into m^3	
25 ^oC into Kelvin	
300 Kelvin into ^oC	
3.5 m^3 into dm^3	
5.5 kPa into Pa	

(10 marks)