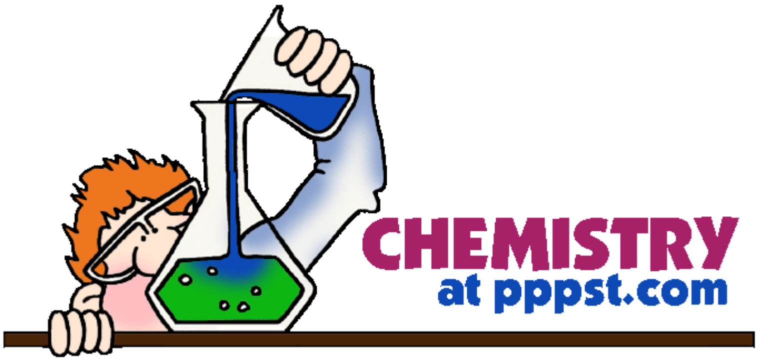
Quintin Kynaston
A SPECIALIST TECHNOLOGY SCHOOL



A2 Chemistry

Course Information

2011 - 2012

Course Details:
A2 Chemistry
Chemistry H434
http://www.ocr.org.uk/qualifications/type/gce/science/chemistry_a/index.html

Teachers:
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Name: ____________________________________

Tutor Group: ______________________________

Contents

Drop –in Study and Homework club

Wednesday after school you will be able to go to SC3 for help with Chemistry homework and work covered within the week.

Assessment

Course: OCR Chemistry A H034/ H434

Module	Weightings	Assessment details
Atoms, Bonds and Groups	15% (30% of AS)	Jan Yr 12 (60 min)
Chains, Energy and Resources	25% (50% of AS)	June Yr 12 (105 min)
Practical Skills in Chemistry 1	10% (20% of AS)	Throughout Yr 12
Rings, Polymers and Analysis	15%	Jan Yr 13 (60 min)
Equilibria, Energetics and Elements	25%	June Yr 13 (105 min)
Practical Skills in Chemistry 2	10%	Throughout Yr 13

Assessment Criteria

Exam questions will assess the following objectives in relation to the content covered within each module (see the Learning Objectives section):

- Knowledge and understanding of science and of How Science Works
- Application of knowledge and understanding of science and of How Science Works
- How Science Works

AO Weightings in Advanced GCE

Unit	% of Advanced GCE			
	AO1	AO2	AO3	Total
AS Unit F321: *Atoms, Bonds and Groups*	7	7	1	15%
AS Unit F322: *Chains, Energy and Resources*	10.5	12	2.5	25%
AS Unit F323: *Practical Skills in Chemistry 1*	1.5	1	7.5	10%
A2 Unit F324: *Rings, Polymers and Analysis*	5	9	1	15%
A2 Unit F325: *Equilibria, Energetics and Elements*	9	13.5	2.5	25%
A2 Unit F326: *Practical Skills in Chemistry 2*	1	1.5	7.5	10%
	34%	44.%	22%	100%

	Assessment Objective 1	Assessment Objective 2	Assessment Objective 3
Assessment Objectives	**Knowledge and understanding of science** **and of How Science Works** Candidates should be able to: • recognise, recall and show understanding of scientific knowledge; • select, organise and communicate relevant information in a variety of forms.	**understanding of science and of How Science Works** Candidates should be able to: • analyse and evaluate scientific knowledge and processes; • apply scientific knowledge and processes to unfamiliar situations including those related to issues; • assess the validity, reliability and credibility of scientific information.	**How Science Works** Candidates should be able to: • demonstrate and describe ethical, safe and skilful practical techniques and processes, selecting appropriate qualitative and quantitative methods; • make, record and communicate reliable and valid observations and measurements with appropriate precision and accuracy; • analyse, interpret, explain and evaluate the methodology, results and impact of their own and others' experimental and investigative activities in a variety of ways.
A/B boundary Performance Descriptions	Candidates characteristically: a) demonstrate detailed knowledge and understanding of most principles, concepts and facts from the A2 specification; b) select relevant information from the A2 specification; c) organise and present information clearly in appropriate forms using scientific terminology; d) write equations for most chemical reactions.	Candidates characteristically: a) apply principles and concepts in familiar and new contexts involving several steps in the argument; b) describe significant trends and patterns shown by complex data presented in tabular or graphical form; interpret phenomena with few errors; and present arguments and evaluations clearly; c) evaluate critically the statements, conclusions or data; d) carry out accurately complex calculations specified for A Level; e) use chemical equations in a range of contexts; f) translate successfully data presented as prose, diagrams, drawings, tables or graphs, from one form to another; g) select a wide range of facts, principles and concepts from both AS and A2 specifications; h) link together appropriate facts principles and concepts from different areas of the specification.	Candidates characteristically: a) devise and plan experimental and investigative activities, selecting appropriate techniques; b) demonstrate safe and skilful practical techniques; c) make observations and measurements with appropriate precision and record these methodically; d) interpret, explain, evaluate and communicate the results of their own and others' experimental and investigative activities, in appropriate contexts.
E/U boundary Performance Descriptions	Candidates characteristically: a) demonstrate knowledge and understanding of some principles and facts from the A2 specification; b) select some relevant information from the A2 specification; c) present information using basic terminology from the A2 specification; d) write equations for some chemical reactions.	Candidates characteristically: a) apply given principles or concepts in familiar and new contexts involving a few steps in the argument; b) describe, and provide a limited explanation of, trends or patterns shown by complex data presented in tabular or graphical form; c) identify, when directed, inconsistencies in conclusions or data; d) carry out some steps within calculations e) use some chemical equations; f) translate data successfully from one form to another, in some contexts; g) select some facts, principles and concepts from both AS and A2 specifications; h) put together some facts, principles and concepts from different areas of the specification.	Candidates characteristically: a) devise and plan some aspects of experimental and investigative activities; b) demonstrate safe practical techniques; c) make observations and measurements and record them; d) interpret, explain and communicate some aspects of the results of their own and others' experimental and investigative activities, in appropriate contexts.

Course Outline: A2 Chemistry 2011 – 2012

Week	Date	Teacher A (DKR)	Teacher B (MDS)	Assessment
1	5th Sept			
2	12th Sept	1.1.1. Aromatic chemistry intro 1.1.2. Structure of benzene	1.3.1. Separation by chromatography	
		1.1.3. Delocalised model 1.1.4. Reaction of benzene	1.3.2. Thin layer chromatography	
3	19th Sept	1.1.5. Substitution reactions of benzene 1.1.6. Reactivity of alkenes and benzene	1.3.3. Gas chromatography	
		1.1.7. Phenols 1.1.8. Bromination of phenol	1.3.4. GC-MS	
4	26th Sept	Revision	1.3.5. NMR intro	
		1.1.9. Intro- carbonyl compounds 1.1.10. Oxidation of alcohols and aldehydes	1.3.6. carbon-13 NMR	Unit 1: Module 1 Homework
5	3th Oct	1.1.11. Reactions of aldehydes and ketones 1.1.12. Chemical tests - carbonyl compounds	1.3.7. Analysis of ^{13}C NMR spectra	
		1.1.13. Carboxylic acids	1.3.8. Proton NMR	
6	10th Oct	1.1.14. Esters	1.3.9. Spin-spin coupling	
		1.1.15. Fats and oils 1.1.16. Triglycerides	1.3.10. –OH and –NH spectra	
7	17th Oct	1.1.17. Amines 1.1.18. Amines and their reactions	1.3.11. Spin-spin coupling examples	Unit 1: Module 1 Homework
			1.3.12. NMR in medicine	Unit 1: Modules 1 + 3 Test
8	31st Oct	1.2.1. Amino acids 1.2.2 Polypeptides and proteins	1.3.13. Combined techniques	
		1.2.3. Optical isomerism 1.2.4. Condensation polymerisation-polyesters		
9	7th Nov	1.2.5. Condensation polymerisation 1.2.6. Addition & condensation polymerisation	**Practical Coursework**	
		1.2.7. Breaking down polymers		Practical Assessment
10	14th Nov	1.2.8. Organic synthesis of aliphatic compounds 1.2.9. Oganic synthesis - aromatic compounds	2.2.1. Lattice enthalpy	
		1.2.10 Chirality in pharmaceutical synthesis	2.2.2. Born-Haber cycles	Unit 1: Module 1 + 2 Homework
11	21st Nov	2.1.1 Rate of reaction	2.2.3. Born-Haber cycle calculations	

		2.1.2 measuring reaction rates	2.2.4. Further examples	
12	28th Nov	2.1.3 Orders and rate 2.1.4 Half-lives	2.2.5. Enthalpy change of solution	
		2.1.5 Orders from rate-concentration graphs		
13	5th Dec		Revision	
14	12th Dec	Unit 1 mock		Unit 1 Mock

Week	Date	Teacher A (DKR)	Teacher B (MDS)	Assessment
15	Thurs 5th Jan			
16	9th Jan	2.1.6. Initial rates + rate constant 2.1.7. Rate-determining step	2.2.6. Hydration and lattice enthalpies	
		2.1.8. The equilibrium constant K_c		
17	16th Jan	2.1.9. Calculations using $K_{c,}$ 2.1.10. Equilibrium position and K_c	2.2.7. Entropy	
		2.1.11. The equilibrium constant, K_c and the rate constant *k*	2.2.8. Free energy	Unit 2, module 1 Homework
18	23rd Jan	2.1.12. The road to acids, 2.1.13. Role of H^+ in reactions of acids	2.2.9. Redox	
		2.1.14. Conjugate acid-base pairs, 2.1.15. What is pH?		Unit 2, module 1 Homework
19	30th Jan	2.1.16. Strong + weak acids, 2.1.17. Calc pH -strong & weak acids	2.2.10. Cells and half cells	
		2.1.18. The ionisation of water, 2.1.19. pH values of bases		
20	6th Feb	2.1.20. Buffer solutions, 2.1.21. pH values of buffer solutions	2.2.11. Cell potentials	
		2.1.22. Neutralisation – titration curves		
21	20th Feb	2.1.23. Neutralisation – enthalpy changes	2.2.12. The feasibility of reactions	
22	27th Feb	Practical Coursework	2.2.13. Storage and fuel cells	Practical Assessment
		Practical Coursework	2.2.14. Hydrogen for the future	
23	5th March	Practical Coursework	Unit 2.1 and 2.2 Practice Exam	Practical Assessment
		Practical Coursework		
24	12th March	2.3.1. Transition metals 2.3.2. Properties of transition metal compounds	2.3.4. Transition metals and complex ions	
		2.3.3. Catalysis and precipitation	2.3.5. Stereoisomerism in complex ions	
25	19th March	2.3.6. Bidentate + multidentate ligands, 2.3.7. Ligand sub in complex	2.3.9. Redox titrations	

		ions		
		2.3.8. Ligand substitution and stability constants	2.3.10. Examples of redox titrations	
26	26th March	2.3.11. Redox titrations – iodine and thiosulfate	Coursework	Module 2 Revision
27	16th April	Unit 2 Revision	Revision	Unit 2 Test

Lesson Objectives

You will be given an objective sheet at the start of each module. You will use this at the start of each lesson to complete the date section on the handout. You must keep this in your folder and take it to every lesson. See below for an example.

Module 1 – Rings, acids and amines	
Arenes	**Date**
Compare the Kekule and delocalised models for benzene in terms of p-orbital overlap forming π bonds.	14/09/10
Review the evidence for a delocalised model of benzene in terms of bond lengths, enthalpy change of hydrogenation and resistance to reaction.	14/09/10
Describe the electrophilic substitution of arenes with: (i) concentrated nitric acid in the presence of concentrated sulfuric acid (ii) a halogen in the presence of a halogen carrier.	15/09/10

Examiners' Tips

General guidance

There are a number of areas that often cause problems for students when answering various examination questions. These tips should help you avoid such problems and are essential to good examination technique.

Practise questions on past examination papers and check the corresponding mark schemes. These can be an invaluable learning and revision resource. However, don't expect *exactly* the same questions to come up on your examination paper – be prepared to *adapt* your knowledge to suit the question.

Always read the question fully and carefully (at least twice!) before beginning your answer. A common mistake is for candidates to incorrectly transfer a number in the question, such as writing down 36 instead of 30.

Diagrams and sketch graphs can earn marks – often more easily and quickly than written explanations – but they will only earn marks if they are carefully drawn.

If asked to draw or sketch a graph, always ensure you use a sensible scale and label both axes with quantities and units. If plotting a graph, use a pencil and draw small crosses or dots for the points. Diagrams must always be neat, clear and fully labelled.

Using bullet points in written explanations can sometimes help you concentrate on the actual answer.

Each module of the A2 chemistry specification consists of a series of *learning outcomes* – i.e. what you are supposed to know! It forms the basis of what the examiner will ask you in the examination. Not surprisingly, it's essential that you are familiar with as many of these *learning outcomes* as possible before entering the examination room.

At A2, the exams are synoptic with a likely overlap with the respective AS unit. For example, the A2 Unit F324: *Rings, polymers and analysis* will have questions relating to some of the basic organic material covered in the AS F322 Unit: *Chains, energy and resources*. Similarly, the A2 F325 Unit: *Equilibria, energetics and elements* will have questions relating to the *Energy* section of the AS Unit F322 as well as with the *Electrons, bonding and structure* section of the AS Unit F321.

You will still need to know the work covered in AS Unit F321: Module 1 – *Atoms and reactions* in order to carry out any appropriate calculations.

Remember, scientific words have *specific* meanings and these meanings may differ to those used in everyday language – a particular language/format is used in chemistry so that chemists know exactly what is meant by other chemists when explaining certain concepts.
Formal definitions have to be used. Most of these were covered during the AS course, but key definitions are also found at A2. It is important that you learn these definitions (highlighted in the unit/module section below).

To help guide you through the A2 course, these tips have been organised according to the relevant unit modules – with the modules further subdivided into sections. This will enable you to dip in and out as you need to.

Remember, each tip is just a *guide* to what you might be asked – it won't contain all the information you'll need but just some basic points to help you. The actual learning is down to you. I can only point you in the right direction.

Calculations in chemistry

Some skills acquired at AS will be used throughout A2 and a number of marks in an A2 chemistry paper will be given over to calculations.

You will need to remember what is meant by *empirical formula* and *molecular formula* and how to calculate both of them from percentage by mass data.

The following relationships will feature throughout the A2 course.

- The relationship between *mol*, *mass* and Molar mass, *M*, for all substances.

  Key fact: 1 mol = *M* in grams

  Although there are many ways to work out calculations involving these units, it's a good idea to learn the equation for interconverting mol, mass and M which is:

  $$\text{mass (g)} = n\text{ (mol)} \times M\text{ (gmol}^{-1}\text{)}$$

  Now you can rearrange the equation to find the term being asked for in the question.

- The relationship between *mol* and *24dm³* for gases.

  Key fact: 1mol of any gas = $24dm^3$ ($24000cm^3$) at room temperature and pressure

  Learn the equation for interconverting mol, volume and $24dm^3$ which is:

  $$\text{volume (dm}^3\text{)} = n\text{ (mol)} \times 24\text{ (dm}^3\text{)}$$

  $$\text{volume (cm}^3\text{)} = n\text{ (mol)} \times 24000\text{ (cm}^3\text{)}$$

  Now you can rearrange the equation to find the term being asked for in the question.

- The relationship between *mol* and *concentration* for solutions.

  Key fact: $1moldm^{-3}$ = 1mol of substance dissolved in water to give $1000cm^3$ of solution

  Learn the equation for interconverting mol, concentration and volume of solution in dm^3 which is:

  $$n\text{ (mol)} = \text{concentration (moldm}^{-3}\text{)} \times \text{volume of solution (dm}^3\text{)}$$

  Now you can rearrange the equation to find the term being asked for in the question. However, most volumes are given in cm^3 which means the equation becomes:

  $$n\text{ (mol)} = \text{concentration (moldm}^{-3}\text{)} \times \frac{\text{volume of solution (cm}^3\text{)}}{1000}$$

The big difference between AS and A2 is that any calculations involving these relationships will be unstructured. In other words, the question will not be split into subsections that guide you towards a final answer. Rather, you will be given some basic information from which you will be expected to derive the required answer. However, the general approach is still the same.

Step 1: work out how many moles of the first substance reacted. Do this using one of the three formulae above.

Step 2: look at the balanced equation to see how many moles of the other substance reacted.

Step 3: use one of the three formulae to calculate the mass/volume of gas/concentration of solution of the second substance.

Points to note by module

Each module of the physics specification consists of a series of *Learning Outcomes* and these outcomes often revolve around specific definitions, for example, the volt or the Newton. Make sure you highlight these definitions in your revision and learn them. See the separate Glossary booklet.

You will be given an Examiner's Tips section for each module. See below for an example.

Module 1 – Rings, acids and amines
Arenes
• Arenes feature throughout organic chemistry. ▪ They have their own particular way of reacting due to their bonding. ▪ The delocalised ring of electrons is very stable and usually will not react without the presence of a catalyst – often referred to as a halogen carrier. • The benzene ring will undergo a mechanism known as *electrophilic substitution*. ▪ You will need to describe this mechanism – curly arrows and all! ▪ You should be able to identify the electrophiles which take part in this reaction such as NO_2^+ and X^+ (X being a halogen). ▪ Each electrophile has its own particular catalyst – you will also need to learn the role of the specific catalyst in this mechanism.

Sample Exam Questions

A2 Unit F324: Rings, polymers and analysis

Module 1: Rings, acids and amines	
Question 1	**Total marks: 15**
(a) **Describe the shape of a benzene molecule and the type of bonding within it.**	**Marks available: 3**

Student answer:

(a) Benzene molecules are planar and have bond angles of 120°.

Each carbon atom has a sigma bond to the next carbon atom and a hydrogen atom.

The p-orbitals overlap in a sideways manner to form a delocalised π bonding system around the carbon ring.

Examiner comments:

(a) It is always a good idea to give bond angles as well as the shape of the molecule in question. Avoid the common mistake of referring to *π bonds* as *p bonds*.

(b) **The reaction between benzene and chlorine takes place in the presence of an aluminium chloride catalyst.**

(i) **Write the equation for the reaction between benzene with chlorine.**

(ii) **Describe the mechanism for this reaction. Use the curly arrow model in your answer and equations to show the role played by the catalyst.**

(iii) **Explain why phenol does not need a catalyst in order to react with chlorine.**

Marks available:

(i) 1 (ii) 5 (iii) 2

Student answer:

(b) (i) $C_6H_6 + Cl_2 \rightarrow C_6H_5Cl + HCl$

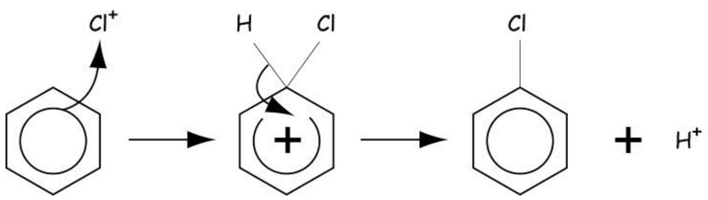
(ii) Step 1

The aluminium chloride catalyst reacts with chlorine to form a Cl^+ electrophile.

$AlCl_3 + Cl_2 \rightarrow AlCl_4^- + Cl^+$

Step 2

A pair of electrons from the delocalised ring forms a bond with the Cl^+ electrophile.



This creates a non-aromatic intermediate species with four bonds on one carbon atom. The proton is then released by two electrons moving back into the ring, forming a stable molecule once again.

Step 3

The H^+ ion then reacts with the $AlCl_4^-$ produced in step 1 to regenerate the aluminium chloride catalyst.

$AlCl_4^- + H^+ \rightarrow AlCl_3 + HCl$

(iii) The lone pairs of electrons on the oxygen atom in phenol (C_6H_5OH) partially delocalise into the benzene ring, which increases the electron density within the ring and makes it more susceptible to attack by electrophiles such as Cl^+.

Examiner comments:

(b) (i) C_6H_6 (benzene) can also be represented by its structural form (i.e. a benzene ring) in equations.

(ii) A diagram is usually the best method of describing a mechanism. The curly arrow model shows the movement of a pair of electrons. Make sure all the curly arrows leave from a bond as shown here in Step 2.

(iii) Make sure you give any electrophiles the correct (+ve) charge. Remember it is only a *partial* delocalisation.

(c) Butanone and butanal are both carbonyl compounds and isomers of each other.

(i) Describe a chemical test which would confirm that both butanal and butanone contain a carbonyl group.

(ii) Describe a chemical test which would differentiate between butanal and butanone.

Marks available:
(i) 2 (ii) 2

Student answer:

(c) (i) Add 2,4-dinitrophenylhydrazine to the solutions. An orange/yellow precipitate will form if a carbonyl compound is present.

(ii) Add Tollens' reagent and warm. Butanal can be oxidised and reduces the silver ions in Tollens' reagent to form silver atoms which are deposited as a silver mirror on the inside surface of the test tube. No silver mirror would be seen with butanone.

Examiner comments:

(c) (i) Remember, in an exam, 2,4-dinitrophenylhydrazine can be shortened to 2,4-DNPH (Brady's reagent).

(ii) This answer relies upon the ability of aldehydes (e.g. butanal) to be oxidised. So another correct response could be as follows: Heat with acidified potassium dichromate. Butanal will turn the solution from orange to green. The solution remains orange with butanone.
In both cases, it is good practice to state what the non-reacting substance (i.e. the butanone – a ketone – in this instance) would do.

Module 1: Rings, acids and amines	
Question 2	**Total marks: 15**

(a) **Liquid pure ethanoic acid reacts with aqueous sodium carbonate at room temperature. Describe what you would see and write the equation for the reaction, including state symbols.**

Marks available: 3

Student answer:

(a) The mixture would effervesce.

$2CH_3COOH(l) + Na_2CO_3(aq) \rightarrow 2CH_3COO^-Na^+(aq) + H_2O(l) + CO_2(g)$

Examiner comments:

(a) It would be acceptable to say fizz instead of effervesce. Remember to read the question carefully. You are told that the acid is a *liquid* (state symbol l) and the sodium carbonate is *aqueous* (aq). All you need to realise is that sodium salts of carboxylic acids are soluble, so they would be aqueous and have the state symbol (aq).

(b) **Methylethyl butanoate $CH_3–CH_2–CH_2–COO–CH(CH_3)–CH_3$ is an ester with a fruity smell. This ester will undergo alkaline hydrolysis. Draw and name the structures of the organic products from this reaction.**

Marks available: 3

Student answer:

(b) $CH_3–CH_2–CH_2–COO^-Na^+$ Sodium butanoate

$CH_3–CHOH–CH_3$ Propan-2-ol

Examiner comments:

(b) One frequent error students make is to place the Na^+ ion with the alcohol product and form butanoic acid as the other product.

(c) 4-nitromethylbenzene can be converted to 4-aminomethylbenzene.

(i) Give the reagents and conditions needed for this reaction.

(ii) What type of reaction has occurred?

(iii) Write the equation for the reaction.

Marks available:

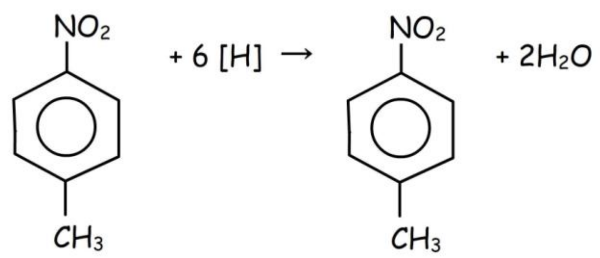
(i) 1 (ii) 1 (iii) 1

Student answer:

(c) (i) Reflux with tin and concentrated hydrochloric acid

(ii) Reduction

(iii)



Examiner comments:

(c) (i) This is the only place in the specification where this reducing agent is used.

(ii) The tin and HCl react to form hydrogen which *reduces* the 4-nitromethylbenzene by removing oxygen atoms from the NO_2 group to form water and *replacing* them with hydrogen atoms.

(iii) The equation has been correctly balanced. Note the reducing agent does not feature in the equation, just [H] – representing *hydrogen atoms from the reducing reagent* – has been used.

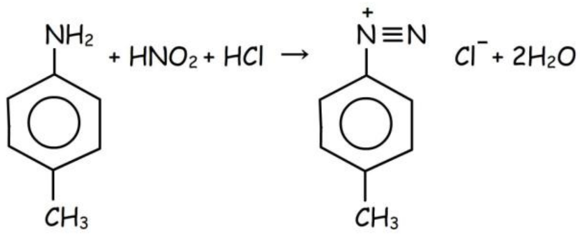
(d) **4-aminomethylbenzene can be converted into an azo dye in two stages. Outline how this conversion can be carried out. Give any relevant equations and draw the structure of the azo dye.**

Marks available: 6

Student answer:

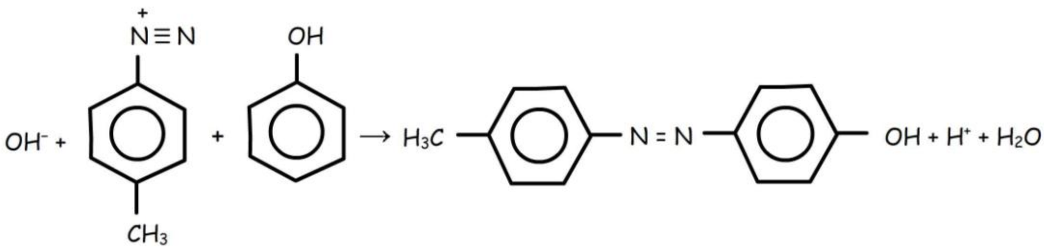
(d) Stage 1

React 4-aminomethylbenzene with nitrous acid, HNO_2 (which is generated from $NaNO_2$ + HCl), at a temperature below 10 °C. This forms methylbenzenediazonium chloride.



Stage 2

Methylbenzenediazonium chloride is reacted with phenol under alkaline conditions (e.g. aqueous sodium hydroxide).



Examiner comments:

(d) If you are representing the equation using a structural version, be very careful about the placing of the positive charge on the methylbenzenediazonium ion – it should appear as benzene –N^+≡N.

Note the methylbenzenediazonium ion couples with the phenol at the 4- position.

Practical Assessment

What are practical skills?

- This is the formal internal assessment of your practical work, entitled *Practical Skills in Chemistry 2* (unit code F326).
- Your practical and investigative skills will be developed during the A2 course under the guidance of your teacher(s).
- The A2 practical skills will build upon those developed during your AS course.
- You will carry out three different types of task set by OCR.

How much are practical skills worth?

- The practical skills assessments are worth 40 marks, which will be scaled by OCR to a mark out of 60. This represents 10% of the maximum of 600 marks for the A level course.
- Remember that for *every* four marks you gain from your practical skills assessments, you will achieve 1% towards your final A level percentage.

Who does the marking and when?

- Your teacher will mark all your practical skills exercises as you do them throughout your A2 course, using a mark scheme provided by OCR.
- The marking will be checked by OCR moderators. Marks can be changed to bring the marks of your school or college into line with those from other teaching centres around the country.

What proportion of the formal assessments will be done in lessons?

- As with all your coursework, your teacher must be able to verify that the tasks have been undertaken by you alone.
- Both you and your teacher will have to sign documents to this effect.
- All tasks will be carried out under supervision during lesson time.

What tasks do I have to do?

- All tasks will be set by OCR.
- There are *three* types of tasks that are used to assess practical skills:
    - A qualitative task worth 10 marks
    - A quantitative task worth 15 marks
    - An evaluative task worth 15 marks.

What is covered by the qualitative task?

- You have to carry out a practical task using instructions supplied by OCR.
- You are expected to perform the task skilfully and safely using *qualitative* techniques – generally few or no calculations.
- Possible types of task are described later in this document.
- You will need to make and record valid observations and organise them in an appropriate way.

What is covered by the quantitative task?

- You have to carry out a practical task using instructions supplied by OCR.
- You are expected to perform the task skilfully and safely using *quantitative* techniques – generally involving detailed calculations.
- Possible types of task are described later in this document.
- You will need to make and record accurate observations and organise them in an appropriate way.
- You will then process your results to reach valid conclusions.

What is covered by the evaluative task?

- You will carry out an evaluative task using instructions supplied by OCR.
- Evaluative tasks will not require additional data collection.
- An evaluative task may extend one of the qualitative or quantitative tasks.
- You will need to be able to:
    - recognise trends in data and identify anomalies
    - reach valid conclusions
    - assess the reliability and accuracy of an experimental task
    - identify significant weaknesses in procedures and measurements
    - understand and select simple improvements to procedures and measurements.

Do I have to plan a practical?

- No, but you may be required to suggest changes to techniques or apparatus which will improve the accuracy or reliability of the results and/or the validity of the conclusions.

Will every piece of practical work be assessed?

- No. OCR provides certain tasks for assessment which can be done at any point during the course. Your teacher will do other practical work with you to develop your skills, but this will not be assessed.
- The *minimum* number of practical assessments would be one for each of the three tasks; however, you may do more than one of each type.

If I do more than three practical assessments, which ones count towards A2?

- Your final mark out of a possible 40 will be made up of the *best* scores that you achieve for a qualitative task, a quantitative task and an evaluative task.
- Remember that more marks are available for the *quantitative* and *evaluative* tasks.

Is there any change in emphasis from AS practical assessment?

- The change is minimal.
- There may be slightly *greater* emphasis on the validity, reliability and credibility of scientific information.
- There may be slightly *less* emphasis on the recall of scientific knowledge and on the selection, organisation and communication of relevant information.

The qualitative task

Possible qualitative tasks include:

- Hydrolysis of an ester – see OCR specimen task
- Other organic preparations
- Redox reactions
- Precipitation of transition metal hydroxides
- Ligand substitution reactions.

When carrying out qualitative tasks:

- You may be expected to comment on the safety aspects of the experiment. Such comments should be *relevant* to the practical you are doing and *not* just general safety comments.
- You may be expected to choose the most appropriate piece of equipment from a list and explain your choice.
- Organise your work area and wipe up any spillages *immediately*.
- Wear safety glasses and gloves when advised to do so.
- When using measuring cylinders, dropping pipettes and other items to measure your chemicals, keep these items next to the appropriate chemical container to avoid potential contamination from other chemicals.
- Dispose of chemicals as instructed – this may *not* be down a sink.
- Transfer reactions to a fume cupboard if noxious fumes are produced.
- You may be asked to make a record of *all* observations such as changes in colour or temperature, or smells – do *not* deliberately smell substances unless specifically asked to!
- Although unlikely in a qualitative task, you may be asked to:
- measure with the degree of precision consistent with the equipment used to make the measurements
- record such measurements to the correct number of significant figures
- *always* give units
- repeat measurements where necessary and calculate an average.
- When heating your apparatus do *not* leave it unattended.
- Remember that overheating salts can result in thermal decomposition producing harmful, irritating or toxic gases!
- When using glassware ensure it is assembled properly and is free from any leaks – e.g. use Quickfit for organic preparations. Clamps should be used on boiling flasks (tight), on condensers (loose) and on delivery tubes to avoid any loss of material.

The quantitative task

Possible quantitative tasks include:

- The continuous monitoring of rates of reaction and plotting of quantity against time graphs
- Clock reactions for determining orders and rate constants by initial rates and rate-concentration graphs
- Determining the formula of hydrated iron(II) sulfate – see OCR specimen task
- Estimating the concentration of iron in iron tablets (redox titration using Fe^{2+}/MnO_4^-)
- Estimating the concentration of copper in an alloy (redox titration using $I_2/S_2O_3^{2-}$)
- Measuring enthalpy changes
- Investigating buffers.

When carrying out quantitative tasks:

- The points already listed for carrying out qualitative tasks also apply to quantitative tasks.
- Burettes and pipettes should first be washed thoroughly in water, followed by a small amount of the *solution* which is to be *measured*.
- Initial and final burette readings should be recorded.
- Titration results should be quoted to the nearest 0.05 cm^3.
- When calculating the mean titre, it is important to *tick* the results you have used – those within 0.10 cm^3 of each other (i.e. concordant results). Only include the *concordant* results in your average. You are expected to be able to obtain closer repeats at A2.
- Remember to cross out the word *trial* if you intend to use the rough reading.
- When carrying out dilutions, it is important to fill up to the *mark* on the volumetric flask with deionised or distilled water rather than just adding a fixed amount of water. For example, to dilute 25.0 cm^3 of acid to 250 cm^3 you *don't* add 225 cm^3 of water to the acid.
- When carrying out calculations, it is important to *explain* each line of your working. For example: amount of acid used = 2.00 × 25.0/1000 = 0.0500 mol
- It is also important to use the correct units at each stage of the calculation – e.g. kJ for kilojoules, *not* KJ, kj *or* Kj.
- Superscripts must be used where appropriate – e.g. dm^3 *not* dm3.
- Subscripts in formulae must also be used – e.g. H_2O *not* H2O.
- The accuracy of the final answer is dictated by the *least* accurate piece of data. For example, data accurate to three significant figures but using a mass of 0.10 g (two sig fig) would suggest that any final answer should be quoted to 2 sig fig. However, it is acceptable to use one more significant figure in your working than in your answer. Avoid *increasing* the number of significant figures from one line of working to the next. In certain tasks you may be expected to be more rigorous about significant figures at A2.
- When plotting graphs you need to consider the following:
    - Is the origin, (0, 0), a point?
    - Which quantity should go on the x-axis? In science this is generally the *independent* variable; however, this is not always the case in chemistry. For example, if time is plotted on the x-axis as in continuously-monitored rate graphs, the gradient of the line will then represent the rate.
    - Scales must be linear and be appropriate for the size of graph paper used.

- Scales must be labelled, with the physical quantity being measured and its units given.
- Tangents and gradients should be clearly shown. Δy and Δx values should be quoted *before* calculating gradients. For initial rates, the tangent should be drawn at time = zero.

The evaluative task

Possible evaluative tasks include:

- Determining the percentage of water of crystallisation in a hydrated salt – see OCR specimen task comparing a titration with a displacement reaction
- Enthalpy changes
- Rates of reaction
- Determining K_c for an equilibrium
- Identifying an organic compound using spectral data.

When carrying out evaluative tasks:

- You should be able to identify anomalous results and hence assess the reliability of the experiment.
- You may have to perform some calculations using the correct mean of a set of results.
- When carrying out a practical, it is extremely helpful to note any procedural errors *as they happen*.
- You will probably be asked to put certain errors in order of significance.
- You have to be able to calculate the potential percentage error of your measurements.
- In order to compare procedural and measurement errors, you may also be expected to estimate percentage errors of your procedural errors. However, this is not always possible.
- You must be prepared to suggest modifications to procedures or to any apparatus which would improve the accuracy of an experiment. Your modifications should be achievable in a *school or college* laboratory.
- You need to be able to calculate amounts of chemicals in *moles*, in order to determine whether a particular chemical is in excess.
- You need to understand how purification steps in an organic synthesis can lead to loss of product.
- You should appreciate the limitations of data recorded in certain experiments – e.g. the times obtained in clock reactions. You should take care when using stopwatches, as although a stopwatch will read to 0.01 s, human reaction time is at least 0.1 s, therefore Δt is not 0.01 s but 0.1 s.

What you need for a practical assessment

Equipment

- Calculator
- 30 cm ruler
- Flexible curve – helps to draw curves if needed
- Sharp pencil
- Blue/black pen

Reference items

- OCR *Data Sheet* including a Periodic Table

Getting the basics right - study skills

- **Keep your notes organised**

  Your folder (with dividers) should be taken to every lesson. You should have a section in your folder for the following:
  - DKR – notes
  - DKR homework
  - MDS – notes
  - MDS homework
  - Formal assessments (Anything with a green sticker!)

- **Make sure you know what you are studying**

  This may sound obvious but it is quite easy to get swamped by all the new material. Print out a copy of the specification, which can be found on OCR's website (www.ocr.org.uk) under 'GCE Chemistry A', and put it in your file. This will tell you exactly what you need to know, including learning outcomes, lists of equations and details of the terms you need to be able to define. Your OCR textbook follows the specification closely, so they can be used in conjunction to help build up your knowledge.

Getting the basics right - exam skills

- **Make sure your writing is legible**

Your handwriting does not have to be perfect *copperplate* but the examiner must be able to read it! When you're in a hurry it's easy to write key words that are difficult to decipher. Practise quickly writing ethane and ethene (or ethanol and ethanal) alongside each other. Then ask a friend to read the words back to you – can they tell the difference?

- **Write all numerical answers on the lines provided**

Occasionally, where more than one step is involved you will have stage answers, and it is sometimes difficult to see which answer has finally been arrived at. If there is more than one set of sums make it clear to the examiner which is your final answer.

- **Avoid using *quirky* letters**

Everybody has their individual writing style but there are occasions when style has to give way to conformity. For example, use a clear letter K to represent potassium's symbol rather than a stylised one, K, which may be hard for the examiner to decipher. Also ensure that your lower case letters are not easily confused with your capital letters. For instance, putting a horizontal tail on a lower case letter l can effectively convert it to a capital L and may lose you marks if you've been asked to write the symbol for aluminium, Al not AL! Furthermore, be careful when writing units; you don't want your correct unit of $kJmol^{-1}$ being read as an incorrect $Kjmol^{-1}$.

By carefully reading your exam paper you can also avoid silly mistakes that may lose you vital marks. Here are some tips that should help you during the exam.

- **Look at how the marks are awarded**

As a rule of thumb the going rate for answering questions is around one mark per minute. Along with the writing time this includes any reading and thinking time (and also checking time if the answer is numerical). Use your time proportionately. For instance, if a question says give *two* uses of substance X and there are only *two* marks available, it would be pointless spending 15 minutes writing down everything you know about substance X!

- **Look out for words in** bold

These words are highlighted for your benefit and are to alert you to something in particular. For example, a question may be talking about the hydrocarbons propane, butane and **pentane**. By using bold for **pentane** it may only want you to draw the isomers for this hydrocarbon.

- **Look out for words in *italics***

These are often used for terms which you will have to define or explain. If two words appear in italics then *both* words must be addressed. For instance, 'Explain what is meant by the term *strong acid*', requires that both the terms *strong* and *acid* are explained. If you answered, 'an acid which completely dissociates into ions when dissolved in water', you have only explained the term *strong*. A full answer would be, 'a proton donor which completely dissociates into ions when dissolved in water'.

- **Correcting written errors**

A2 questions are structured in a way that requires you to write in the spaces provided. If you make a mistake, neatly cross through the work you think is wrong and write a fresh answer alongside or above. You can also use asterisks to direct the examiner to your continued answer if you need to use extra space lower down the page. When crossing out, do not heavily obliterate what you have written – a single line through the work will do. You may decide that the work crossed out is in fact the correct answer and it is easier to write, 'crossed out in error – please mark this', rather than rewriting the whole piece.

- **Correcting calculations and numbers**

Never overwrite one number with another. Although it may be obvious to you in the exam room that you have changed a 0 into a 9, by the time your paper reaches the examiner it may be difficult to interpret whether it was a 0 changed to a 9 or a 9 changed to a 0. If you make a mistake, be clear. Cross through the number you think is wrong and write the new number alongside or above.

- **Correcting diagrams and graphs**

In structured papers such as the A2 chemistry papers, there are usually spaces for a diagram or a graph. In these instances you should use a sharp *pencil.* If a mistake is made you can simply rub it out rather than redraw the diagram or graph from scratch. Please be aware that you are not allowed to use liquid paper during examinations.

Getting the basics right - command words

Command words are used to instruct you *how* to answer a question. Consequently, it is vital that you spot these command words and answer the question as the examiner expects. Look at the instructions given in the question.

- **List** – give a simple inventory. Answers can consist of one word, one phrase or one sentence. If the question asks, 'List two uses of substance X', then only give *two*. If you give three uses and one is incorrect you will not receive the full marks allocated for this question – it is not up to the examiner which two answers should be marked.
- **State** – write a simple response to the answer. There is no need for you to explain or expand upon your statement.
- **Describe** – a more detailed answer is required here. The answer may contain diagrams, graphs or tables. If a question asks you to describe an organic mechanism, and states that you may use diagrams if you wish, then use them – the examiner will expect them and can allocate marks accordingly.
- **Define** – give a formal definition. Your specification will state which definitions are required. It is a good idea to learn a response you are confident with for each of these definitions.
- **Explain** – normally used when you are given a fact and asked to explain it, using your chemistry knowledge in your answer.
- **Calculate** – you need to show your working. Even if you give an incorrect answer you may still get method marks if you have clearly shown the correct steps involved in the calculation. For example, a common error when calculating a mass of substance produced in a reaction is using an incorrect relative atomic mass or incorrectly determining a relative molecular mass. However, if this mistake is evident in the first line of your calculation then any subsequent stages (providing they are correct) will still get credit. Examiners call these '*e.c.f*' (error-carried-forward) marks.
- **Predict** – frequently used to establish if you know a trend as stated in the specification, such as the boiling point of the Group 7 element astatine. You would not be expected to know the exact boiling point but you would be expected to know that it would be higher than that of iodine.
- **Outline** – give general principles *not* specific facts. For instance, outlining how the melting points of Group 7 elements change as the group is descended only requires a simple comment that they increase, rather than writing the specific melting point for each element.
- **Sketch** – usually applied to graphs where a trend is known but not the exact figures. The clue here is the term *sketch*, where only the general shape of the curve or gradient of the line is required. Remember that all axes must be labelled.
- **Suggest** – frequently regarded as the hardest type of question, as you will probably *not* know the answer before you enter the exam room. Instead, you will be required to use information gleaned from the question as well as from your previous answers in order to come up with a suitable reply. For this type of question there are often many correct answers.
- **Discuss** – this means a fuller, more detailed account is required.

Getting the basics right – practice questions

Here are some questions from AS for you to try. Remember to note the command words!

1 **List** two uses of ethanol.

2 **State** the names of two alcohol isomers for C_3H_7OH.

3 Draw two isomers of C_3H_7Cl in the boxes shown below.

Isomer 1	
Isomer 2	

4 **Define** standard enthalpy of combustion.

5 **Predict** how the first ionisation of magnesium compares with that of aluminium.

Stretch yourself - study skills

Once you are comfortable that you know your *Learning outcomes* for chemistry, you can start to reinforce this knowledge. There are numerous ways of achieving this; choose the one you have a preference for and that works for you.

The following points are just suggestions. You may wish to use more than one approach or adapt some of them. If you already have your own successful method, then carry on using it!

- **Produce condensed versions of your notes**
  Just include the pertinent information.

- **Use practice exam questions**
  Preferably with specimen answers so you can check your own.

- **Make up your own questions**
  Try your questions with a fellow student and check each other's answers.

- **Convert your work to mnemonics**
  A common one here is OILRIG (oxidation is loss, reduction is gain). Another example could be '**B**az **S**tops **C**atching **M**onkeys' to remember the order of reactivity for the Group 2 metals: barium; strontium; calcium; and magnesium.

- **Use spider diagrams**
  These can be useful when revising organic chemistry. One homologous series can be connected to another with arrows to and from boxes containing the names of the series. The essential reaction conditions can be written above or below the arrows.

- **Practise writing the relevant equations for all the specification reactions**
  There aren't too many and the important equations are usually highlighted within the appropriate module sections. You should earn marks for being able to write these equations correctly.

- **Acquire knowledge that is not directly found within your specification**
  You may wish to use the *New Scientist* link on the *Exam Café* CD.

Although you may find some of the above suggestions useful, it is important to remember that it is *your* revision session and as such should suit *you*. Everyone has an optimum *concentration time* which can be remarkably short. You may therefore find it more useful to revise *little and often* rather than revising for long sessions at a time. Again there are no hard and fast rules on how to revise – it's your personal choice.

Stretch yourself - exam skills

Most of the common pitfalls students encounter and how to avoid them are listed in the *Getting started in AS* section of the AS *Exam Café* CD. Another common hazard is not fully addressing the question. Certain open-ended questions require multiple answers. For instance, for the question, 'Describe what you would see when air reacts with magnesium and with calcium, including any equations', you would need to include *two* observations and *two* equations in your answer – an observation and equation for the magnesium reaction as well as an observation and equation for the calcium reaction.

Practising questions from past papers will also help to improve your exam skills. Completing at least one whole past paper in the run-up to your exam should help you get a feel for the pace of the exam and make the real thing less daunting.

Stretch yourself - command words

You need to be comfortable with all the command words you're likely to come across during your exam, especially the more advanced ones. You'll find fuller explanations for the following command words in the *Getting started in AS* section of the AS *Exam Café* CD under the *Getting the basics right – command words* heading. The command words that require more detailed answers are in italics.

- **List** – give a simple inventory.
- **State** – give a simple response, no need to explain or expand.
- **Define** – give a formal definition.
- **Calculate** – do not forget to show your working.
- ***Describe*** – a more detailed answer is required, possibly containing diagrams, graphs or tables.
- ***Explain*** – normally used when you are given a fact and asked to explain it, using your chemistry knowledge in your answer.
- ***Predict*** – often used to establish if you know a trend as stated in the specification.
- ***Outline*** – give general principles *not* specific facts.
- ***Sketch*** – usually applied to graphs where a trend is known but not the exact figures. The clue here is the term *sketch*, where only the general shape of the curve or gradient of the line is required. Remember that all axes must be labelled.
- ***Suggest*** – frequently regarded as the hardest type of question, as you will probably *not* know the answer before you enter the exam room. Instead, you will be required to use information gleaned from the question as well as from your previous answers in order to come up with a suitable reply. For this type of question there are often many correct answers.
- ***Discuss*** – a full, more detailed account is required. You often need to introduce more than one topic into your response for this type of question.

Stretch yourself - practice questions

Here are some questions from AS for you to try. Remember to note the command words!

1 **Describe** the physical states of chlorine, bromine and iodine at room temperature and explain any trend.

2 **Outline** with the aid of equations the free radical substitution of methane by chlorine.

3 **Sketch** a graph showing how increasing the concentration of a reactant would affect the rate of a chemical reaction.

4 **Discuss** the differences in the reactions of ethane and ethene with bromine.