Resource provided as an example of good practice by Ruth Boddy, at The Grammar School at Leeds.



Chemistry Department, The Grammar School at Leeds

New (2015 onwards) A Level Practical Competencies: our current approach (25th January 2016)

Contents

Aims of our provision

- To continue to maintain a "minds on" approach to practical work at all times. This in turn should help our students to cope with the practical questions within the written papers.
- To integrate AfL principles to practical work.
- To continue to develop our A level students as confident and competent practical chemists. In doing so, to gather evidence to demonstrate that our students have achieved the standards necessary to pass their A level practical component.
- To encourage students to monitor their own progress, engage fully with and take ownership of their practical skills whilst enjoying the learning experience of lab work.
- To document the practical competencies methodically and continuously to enable us to monitor the progress of each student in a convenient and efficient way.

Chemistry department approach

For several years we have developed a culture of minds on Chemistry practical work at all ages and stages. We were therefore keen to continue with this aspect of our provision at A level. To this end, we have developed and published a lab book to our students; selected extracts are attached. Each of the required practicals is included in the lab book, as are other examples of practical work we would wish to complete as a matter of course. Many of the practicals are based on the PSAs from the preceding specification.

To document the students' progress towards the practical competencies we have developed our own spread sheet design. This is based on the spread sheet available through AQA but is a little simpler in terms of deciding the extent to which our students have met a competency and also integrates dates and attendance registers. We have based our approach on our experience some years ago of completing and monitoring PSA experiments (i.e. students are deemed to be confident, require more practice or not met the competency at all).

To strive for consistency across the department: marking/feedback sheets have been produced for the experiments in the lab book and colleagues use these when marking work; the competency record spread sheet is shared and is monitored by the HoD; each colleague who teaches A level Chemistry teacher has completed the AQA online assessment; practical skills and details (e.g. features of tables and graphs) have been discussed as part of our development items in department meetings.

The approaches in the other science departments

At GSAL the three science departments operate autonomously. As such we have each adopted a slightly different approach to the A level practical work. For instance, the Biologists use a more traditional lab book and individual colleagues select which practicals they wish to use (in addition to the required practicals) to enable students to demonstrate the competencies. The Biologists have modified the Chemistry spread sheet for recording competencies to better suit their needs.

Chemistry Practical Lab Book: key features

The lab book contains a mixture of information (e.g. success criteria), written methods (except for experiments where students are asked to plan a method themselves) and self-reflection sheets.

Across the two year course each of the required practicals has been integrated into the lab book, each of the Apparatus and Techniques descriptors (a – l) has been met and several opportunities to demonstrate in full each of the competencies 1 – 5 have been planned.

The students are expected to keep a central record of their own progress:

Experiments:

	Title	Topic	Present during lesson? (Y/N)	Date of prac.	Written up?	Self-evaluation done?
1	Calculate the concentration of hydrochloric acid by titration (page 21)	2				
2	(Required Practical 1) Make up a volumetric solution and carry out an acid-base titration (page 27)	2				
3	Calculate the concentration of ethanoic acid in vinegar (page 37)	2				
4	Determine the A_r of lithium (page 43)	2				
5	Calculate the M_r of a volatile liquid (page 51)	2				

The "minds on" questions are designed to help students to focus on the key method ideas and to engage more actively with their learning, which in turn will prepare them better for the practical questions in the written papers:

Date: .....

Why is it important to re-weigh the weighing boat at this stage? .....

.....

5) Calculate the mas of sodium hydrogensulfate that you transferred into the beaker.

6) Add approximately 100 cm^3 de-ionised water to the beaker containing the solid and use a glass rod to stir the contents of the beaker until all of the sodium hydrogensulfate has dissolved.

7) Using a funnel, pour the contents of the beaker into a 250 cm^3 volumetric (graduated) flask.

8) Use a de-ionised water wash bottle to rinse the beaker and glass rod into the volumetric flask.

Why must the rinsings be added to the flask? .....

.....

9) Sit the volumetric flask onto a flat surface then add de-ionised water until the bottom of the meniscus just sits on the graduation mark. You must make sure your eye is level with the graduation mark. You need to be careful not to over-shoot the mark so you may wish to pour some de-ionised water into a beaker and use a dropping pipette to add the last few drops.

10) Stopper the flask and invert it several times.

Why is it important to invert the flask several times?

.....

.....

Some of the activities require students to plan a method themselves then carry out their own written method:

Date: .....

Experiment 6: Calculate x in $CuSO_4 \cdot xH_2O$

(adapted from PSA5 © AQA 2008)

Introduction:

Hydrated copper (II) sulfate, $CuSO_4 \cdot xH_2O$ contains x moles of water of crystallisation for every one mole of $CuSO_4$. On heating, the water of crystallisation is removed to leave a white powder of anhydrous copper (II) sulfate, $CuSO_4$:

$$CuSO_4 \cdot xH_2O \rightarrow CuSO_4 + xH_2O$$

You are required to plan a method that can be used to work out x.

What we are looking for:

- Research possible methods that could be used to answer the question.
- Choose an appropriate method, equipment and techniques.
- Identify variables for measurement and control. Decide on quantities of substances to be used.
- Carry out a full risk assessment and explain how you are going to minimise risks.
- Write an initial plan for your investigation, making sure that procedural steps are well sequenced.
- Try out the experiment and modify the method if necessary.
- Choose an effective way of recording precise, accurate data methodically using the appropriate units.
- Use appropriate software to process data and report findings, including uncertainties. Number the pages of the report in the format i, ii, iii. Print off and add into your lab book appropriately.

Marking and feedback

To integrate AfL principles, increase efficiency and strive for consistency, marking grids have been developed for each of the lab book experiments. These contain a "general comments about lab book" section as well as sections relevant to that specific experiment. Exemplar worked answers are available on the pupil shared area for some of the experiments.

General comments about lab book:

Recording results as go along.	
Recordings neat and legible.	
Recordings in pen.	
Any mistakes crossed through and re-written (no scribbling out, no tippex).	
Sources quoted clearly, including date accessed for online sources (if applicable).	
Pages are dated.	
No pages are missing.	
Summary sheet on p. 3 up to date.	
You are taking care of your lab book.	
Self-evaluation completed.	

Comments specific to Experiment 3:

Balanced eqn for reaction	
Importance of rinsing burette with NaOH not water	
Importance of adding exact volume in step 2	
Calculate new concentration accurately (0.200 moldm^{-3})	
Measured value recorded and % uncertainty in measured value calculated	
Overall % error calculated	
Absolute error calculated and quoted with calculated concentration	

Concordancy explained	
Data recorded in correct rows and to 2 dp	
Titres calculated accurately	
Concordant data only used for average	
Explanation of ±0.15 cm^3 uncertainty in titre	
Mean titre calculated and quoted to 2 dp	
Moles sodium hydroxide calculated	
Moles ethanoic acid calculated	
Concentration of ethanoic acid calculated	

Students are also expected to self-reflect and set their own targets for improvement:

Date: .....

Experiment 1 Self-evaluation:

	Apparatus and techniques covered	Confident	More practice needed	I need to start from scratch
a	Use burette to measure volume			
d	Use pipette, burette accurately			
k	Safely and carefully handle hydrochloric acid and sodium hydroxide solutions			

	Competencies covered	Confident	More practice needed	I need to start from scratch
1	Follow the method accurately			
2	Use the equipment correctly, including rinsing with the correct solutions, accurate use of the pipette and single drop end point from the burette.			
3	Use the equipment safely, including use of the safety filler, filling the burette below eye level and wearing the correct protective equipment.			
4	Titration data recorded to appropriate precision.			
5	Your data is recorded and analysed appropriately and clearly to draw conclusions (i.e. you have used your data to calculate the concentration of hydrochloric acid, including the uncertainty)			

Recording the practical competencies

S	I	U	V	W	X	Y	Z	AA	AB	AC	A
Type A in this column if Absent. Leave blank if present.	15/9/2015					SMC					
	Experiment 1: Calculate the concentration of hydrochloric acid by titration.										
	Confident					More practice needed					
	1	2	3	4	5	1	2	3	4	5	
	1. Follow method accurately										
	2. Use equipment correctly, in cluding rinsing with correct sol.utions, accurate use of pipette and single drop end point from burette.										
	3. Use equipment safely, including use of safety filler, filling the burette below eye level and wearing the correct protective equipment.										
	4. Titration data recorded to appropriate precision.										
	5. data recorded and analysed appropriately and clearly to draw conclusions (i.e. used data to calculate the concentration of hydrochloric acid, including the uncertainty).										

For each experiment the teacher enters the date and his/her initials. The competency descriptions are available for that experiment.

For each experiment the teacher enters whether each student has demonstrated that competency confidently or whether (s)he needs more practice.

A running total allows us to monitor how often a particular student has demonstrated a particular competency confidently.

A	B	C	D	E	F	G	H	I	J	K	L	M	S	T	U	V	W	X	Y	Z	AA	AB	AC	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN
AdNo	Teachers										Surname	Forename	Type A in this column if Absent. Leave blank if present.	10/09/2015					MJD					Type A in this column if Absent. Leave blank if present.	24/09/2015					MJD			
	Running Total													Experiment 1: Calculate the concentration of hydrochloric acid by titration.											Experiment 2: (Required Practical 1) Make up a volumetric solution and carry out a simple acid-base titration									
	Confident					More practice needed								Confident					More practice needed						Confident					More practice needed			
	1	2	3	4	5	1	2	3	4	5				1	2	3	4	5	1	2	3	4	5		1	2	3	4	5	1	2	3	4
	5	5	5	2	1	1	1	1	2	3				y	y	y						y	y		y	y	y	y						
	6	5	5	1			1			1				y	y	y	y						y	a	y	y								
	7	6	6	2	3		1	1	3	2				y			y	y		y	y				y	y	y	y						
	6	7	7	5	2	1				3				y	y	y	y						y		y	y	y	y						
	7	7	7	3	4				2	1				y	y	y		y				y			y	y	y						y	
	7	7	7	2	1				2	4				y	y	y		y				y			y	y	y	y						