NEW CHEMISTRY ACHIEVEMENT STANDARDS AS2.1 AND 2.2

CHEMISTRY TEACHERS' DAYS 2019

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REVISION BRIEF FROM MoE

- Concerns identified from the RAMP(Science) review plus "issues" arising from Moderation Services [this happened as far back as 2014]
- A greater emphasis on epistemic knowledge – "*the understanding and application of knowledge - production methodologies*".
- To align C2.1 more closely with the equivalent Level 1 and Level 3 standards.
- To require a greater application of knowledge in C2.2 and greater cognition at the Excellence level.

From a presentation by Ian Torrie/sciPAD

AS90925 Biol 1.1 4cr Carry out a practical investigation in a biological context, with direction	AS90926 Biol 1.2 3cr Report on a biological issue	AS90935 Phys 1.1 4cr Carry out a practical physics investigation that leads to a linear mathematical relationship, with direction	AS90936 Phys 1.2 3cr Demonstrate understanding of the physics of an application
AS91153 Biol 2.1 4cr Carry out a practical investigation in a biology context, with supervision.	AS91154 Biol 2.2 3cr Analyse the biological validity of information presented to the public.	AS91168 Phys 2.1 4cr Carry out a practical physics investigation that leads to a non-linear mathematical relationship.	AS91169 Phys 2.2 3cr Demonstrate understanding of physics relevant to a selected context.
AS91601Biol 3.1 4cr Carry out a practical investigation in a biological context, with guidance	AS91602 Biol 3.2 3cr Integrate biological knowledge to develop an informed response to a socio-scientific issue.	AS91521 Phys 3.1 4cr Carry out a practical investigation to test a physics theory relating two variables in a non-linear relationship.	AS91522 Phys 3.2 3cr Demonstrate understanding of the application of physics to a selected context.

SCIENCE/CHEMISTRY MATRIX 2018

L1	AS90930 Chem 1.1 4cr Carry out a practical chemistry investigation, with direction		AS90931 Chem 1.2 2cr Demonstrate understanding of the chemistry in a technological application
L2	AS91161 Chem 2.1 4cr Carry out quantitative analysis.	AS91162 Chem 2.2 3cr Carry out procedures to identify ions present in solution.	AS91163 Chem 2.3 3cr Demonstrate understanding of the chemistry used in the development of a current technology
L3	AS91387 Chem 3.1 4cr Carry out an investigation in chemistry involving quantitative analysis.	AS91388 Chem 3.2 3cr Demonstrate understanding of chemical spectroscopic data in chemistry	AS91389 Chem 3.3 3cr Demonstrate understanding of chemical processes in the world around us.

SCIENCE/CHEMISTRY MATRIX 2018

L1	AS90930 Chem 1.1 4cr Carry out a practical chemistry investigation, with direction		AS90931 Chem 1.2 2cr Demonstrate understanding of the chemistry in a technological application
L2	*AS91910 Chem 2.1 4cr* *Carry out a practical investigation into a substance present in a consumer product using quantitative analysis*	*AS91911 Chem 2.2 3cr* *Carry out an investigation into chemical species present in a sample using qualitative analysis*	AS91163 Chem 2.3 3cr Demonstrate understanding of the chemistry used in the development of a current technology
L3	AS91387 Chem 3.1 4cr Carry out an investigation in chemistry involving quantitative analysis.	AS91388 Chem 3.2 3cr Demonstrate understanding of chemical spectroscopic data in chemstry	AS91389 Chem 3.3 3cr Demonstrate understanding of chemical processes in the world around us.

- **Provides an appropriate transition from C1.1 to C3.1**
- **Purpose of the investigation is clear.**

AS 2.1 CHANGES?

The practical chemistry investigation at NCEA level 2 involves accurately determining the concentration of a substance in the consumer product using quantitative analysis.

Carrying out the investigation requires:

- Planning, including trialling and modifying (if necessary) the procedure you are given
- Using the procedure supplied to collect accurate and valid data (primary data)
- Processing and interpreting data to reach a conclusion. This will include processing secondary data relating to the standard solution,
- Reporting on the investigation which includes justifying changes made to the original method (after trialling) and evaluating the outcome of the investigation in relation to the consumer product being investigated.

The method to be used is known as titration and may involve

- Acid-base reactions
- Oxidation-reduction reactions
- Complex ion formation
- Precipitation reactions

Before you can begin the investigation you will need to be familiar with

- The language and symbols that chemists use to describe concentration and how to carry out the related calculations
- The titration procedure, including how to use the equipment to ensure that your results are accurate and reliable

From: *ESA Level 2 Study Guide Chemistry*

2.1 ANALYSIS OF A HOUSEHOLD CHEMICAL

Obviously students will have done work in class (including multiple titrations) to build up to the assessment. The task has four parts A-D and will be done over four spells

A. Initial trials by individual students – new for technicians

B. Calculation – standardisation (using provided data)

C. Titration – as per previous 2.1

D. Investigation report – new (but no practical work)

PLANNING AND CARRYING OUT THE INVESTIGATION

Information is provided about:

- the consumer product to be investigated
- the titration procedure to be used – including a balanced chemical equation for the reaction, a list of the equipment and the solutions that are available and detailed instructions for carrying out the titration.

Developing a workable plan to determine if the consumer product sample and/or titration procedure requires modification requires trialling to see if the expected titration volumes are appropriate

- Titration volumes (known as titres) should not be too small (less than 10 mL as this reduces that accuracy of your final calculation)
- Titration volumes should not be too large to be practical (greater than 50 mL) - a volume below 25 mL is a good idea as this means that there is less wastage of chemicals and it is more efficient in terms of refilling the burette.
- If the solutions provided would give titre values outside the ideal range the method that has been provided with will need to be modified.
- Trials can be done on a small scale using approximate values. This could mean using a measuring cylinder for the volumes instead of a pipette and mixing the solutions in a beaker.

From: *ESA Level 2 Study Guide Chemistry*

REMEMBER – ACCURACY AND EQUIPMENT:

- Final titre results should ideally fall between 10 and 25 mL.
  - Less than 10 mL means a larger percentage error
  - More than 25 mL is time consuming and wasteful (and some students aren't good at refilling burettes).
- Standard equipment that would be available for carrying out the dilutions would be 10.00 and 25.00 mL pipettes, 100.0 and 250.0 mL volumetric flasks and 50.00 mL burettes.

WHAT DOES INITIAL TRIALING MEAN?

A titration is to be carried out using sodium hydroxide solution to determine the concentration of ethanoic acid in vinegar using phenolphthalein as an indicator. A 20.00 mL pipette is suggested to measure the volume of vinegar solution but there is also a 10.00 mL pipette available.

The aim is to determine the dilution factor needed to get an appropriate titre when the titration procedure provided is used.

Talk about what you would do to find out the dilution factor.

What would you expect students to do?

WHAT WOULD YOU DO WITH THESE RESULTS?

1. 2 mL of vinegar needed 18 mL of NaOH

   So 20 mL would need……..

   What would you do?

   What would you expect for your titration?

   You would now expect that 20 mL of diluted solution will use around 18 mL of the NaOH provided.

- This would mean that 20 mL would use up 180 mL of NaOH which is almost 10 times more that the ideal amount.
- Solution: dilute the vinegar by a factor of 10. This could be done by either pipetting 10.00 mL into a 100.0 mL volumetric flask and making up to the mark with distilled water OR using a 25.00 mL pipette and a 250.0 mL volumetric flask.
- You would now expect that 20 mL of diluted solution will use around 18 mL of the NaOH provided.

From: *ESA Level 2 Study Guide Chemistry*

2. 2 mL of vinegar needed 30 mL of NaOH

   This would mean that 20 mL would use up 300 mL of NaOH which is 15 times more that the ideal amount.

   Solution: dilute the vinegar by a factor of 10 as in 1 above. You would now expect that 20 mL of diluted solution will use around 30 mL of the NaOH provided. This is not ideal as it requires the burette to be filled up for each reading. To get a titre value closer to 20 mL, a 10.00 mL pipette could be used. This would mean that the expected volume is around 15 mL which is within the desired range.

3. 2 mL of vinegar needed 11 mL of NaOH

   This would mean that 20 mL would use up 110 mL of NaOH which is about 5 times more that the ideal amount.

   Solution: dilute the vinegar by a factor of 10 as above. You would now expect that 20 mL of diluted solution will use around 11 mL of the NaOH provided which is within the desired range.

4. 2 mL of vinegar needed 5 mL of NaOH

   This would mean that 20 mL would use up 50 mL of NaOH which is outside the acceptable range

   Solution: Use a 10.00 mL pipette which would give an NaOH volume pf 25 mL.

From: *ESA Level 2 Study Guide Chemistry*

DISCUSSION:

- The suggestion is that Part A is done as a CAT (Common Assessment Task). How would you manage the chemicals and equipment for this trialling process with multiple classes?
- What other implications are there?
- What kind of discussions will you need to have with your TIC Chemistry?
  - Make sure your school is a member of SCENZ (Secondary Chemistry Educators New Zealand) to access the support material. https://nzic.org.nz/scenz/

REPORTING ON THE INVESTIGATION

- The report should include the following:
  - The purpose of the investigation
  - A description of your modified procedure – this must include a description of:
  - How significant variables were controlled, and
  - Any modifications made to the method and/or the solutions necessary when carrying out the procedure
  - A record of the data gathered
  - The calculations used, including ALL working, to determine the concentration of all standard solutions used*, and the determination of the concentration of consumer product being investigated
  - A conclusion which gives the final calculated concentration of the consumer product.
  - A discussion of the investigation which includes:
  - Justification of the modifications made to the procedure to ensure the accuracy of the titration data(based on the trials carried out at the beginning of the investigation)
  - Explanation of how your procedure and control of certain variables improved the quality of the investigation, and
  - Evaluation of the outcome of your investigation by comparing the concentration you determined to the concentration expected according to the manufacturer's standards.

*Also required to calculate the concentration of the standard solution that was provided, using secondary data that will also be given to you.

NEW STANDARD C2.1

- TWO SAMPLE ASSESSMENTS ON TKI
  - REDOX ('BLEACH") + ACID-BASE ("VINEGAR") TITRATION EXEMPLARS
- FULL TEACHING/ASSESSMENT PACKAGE SCENZ
  - HTTPS://NZIC.ORG.NZ/SCENZ/RESOURCES (NEED TO BE LOGGED IN!)
  - INCLUDES A READY TO USE ACID-BASE ("AMMONIA") ASSESSMENT
- A SERIES OF REDOX TITRATION ASSESSMENT TASKS
  - HTTP://WWW.SCHOLARSHIPCHEMISTRY.INFO (HENDERSONHASSELBALCH)
- 1 HR VIDEO OF SCIPAD PRESENTATION
  - HTTPS://SCIPAD.CO.NZ/TALKS

IAN TORRIE

AS 2.2 Carry out an investigation into chemical species present in a sample using qualitative analysis

- This investigation requires the identification of the chemical species present in a given sample, by carrying out a practical chemical procedure. The sample may be an aqueous solution of a salt in which case the cation and the anion present will be determined, or it maybe a liquid or solid containing an organic molecule in which case the functional group present on the molecule will be determined.
- The identification procedure will normally take the form of a flow chart which allows the separation of chemical species from each other based on their chemical properties.
- The investigate requires:
  - Collecting primary data using an identification procedure
  - Linking the identification of the chemical species to the data collected and to data supplied about the procedure
  - Writing relevant equations to explain the changes observed
  - Writing about the significance of the chemical species

From: *ESA Level 2 Study Guide Chemistry*

Carrying out an investigation into chemical species present in a sample using qualitative analysis involves:

Collecting primary data using an identification procedure

- The identification procedure will normally take the form of a flow chart which allows you to separate chemical species from each other based on their chemical properties.

Linking the identification of the chemical species to the data collected and to data supplied about the procedure

- Data supplied about the procedure will be related to information known about the species present that would be used to construct the procedure represented in the flow chart.

Writing relevant equations to explain the changes observed

- When simple enough, each chemical reaction should be represented by a balanced chemical equation.

Writing about the significance of the chemical species

- Scientific literature will be available to allow a summary of the significance of the chemical species identified to people or the environment to be written. This means that when two ions, cation and anion, are identified in an ionic solution, only one of the ions needs to be written about.

From: *ESA Level 2 Study Guide Chemistry*

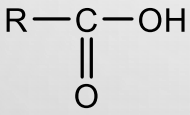
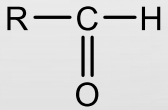
CHANGES FROM PREVIOUS C2.2

- Ions or organic functional groups
- Identification needs to be justified/explained by linking to secondary data (solubility rules, reactions of organic functional groups)
- Significance of the species needs to people or the environment needs to be written using resources provided

ANALYSIS OF ORGANIC COMPOUNDS BASED ON FUNCTIONAL GROUP REACTIONS.

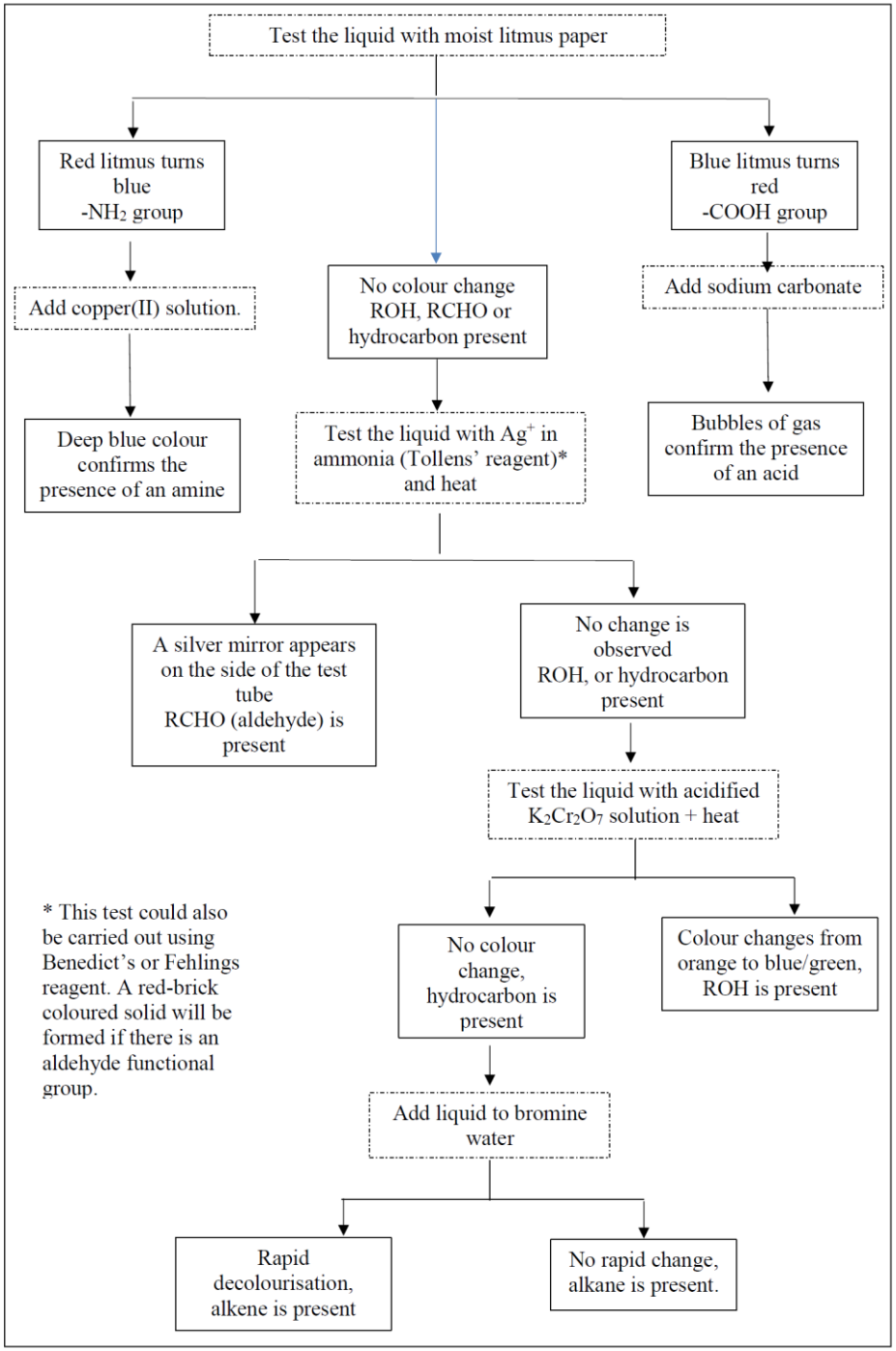
- A scheme to confirm the presence or absence of functional group in an organic molecule could include
  - acid-base reactions,
  - oxidation-reduction reactions
  - solubility.

Functional groups could include:

R-OH			$R\text{-}NH_2$	
alcohol (1^o or 2^o)	carboxylic acid	aldehyde	amine	alkene

What chemicals would you need? What order would you use?

Draw a possible flow chart.



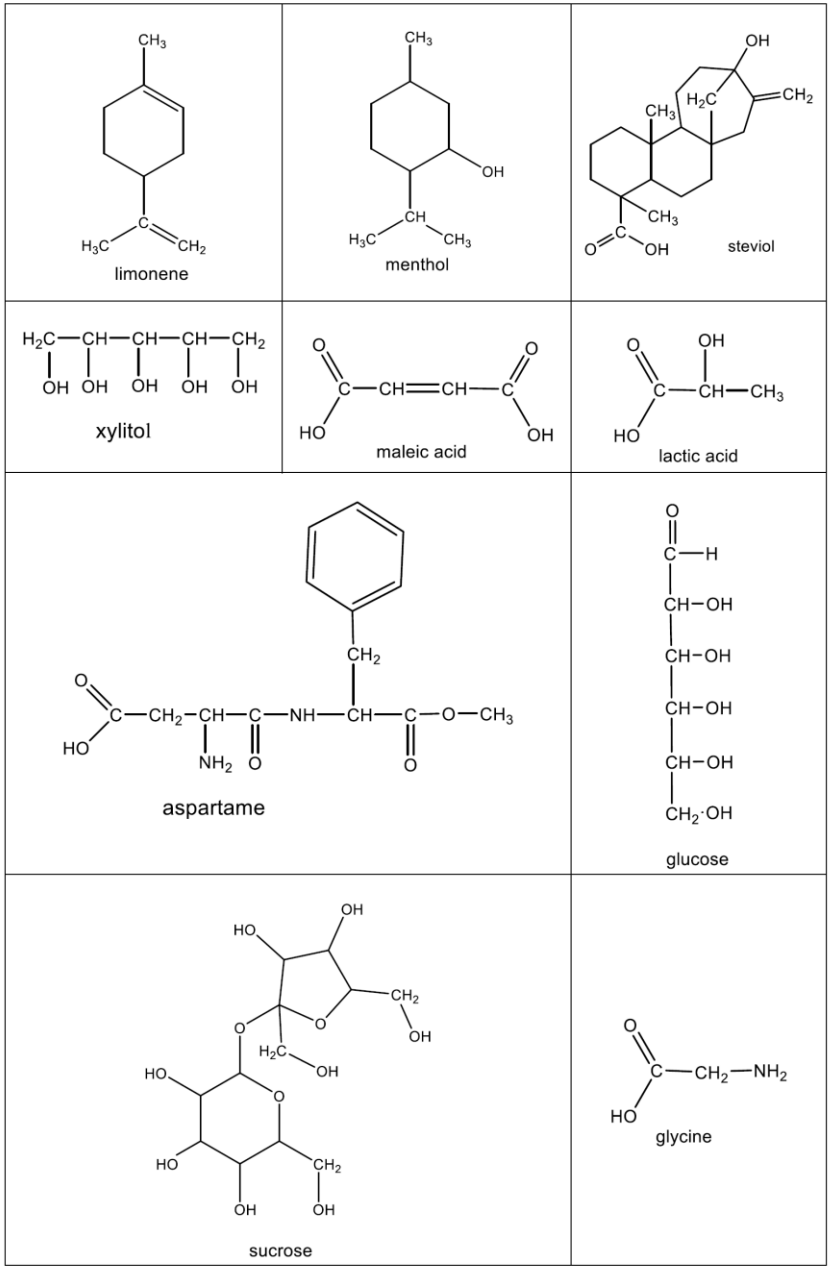
A FLOW CHART FOR ORGANIC UNKNOWNS

- Can be adapted for more/less functional groups
- Alternative reagents include Benedict's or Fehling's solution for aldehydes
- Functional groups outside those used for AS2.5 can be used as the standard is not based on prior knowledge of AS2.5 content

From: *ESA Level 2 Study Guide Chemistry*

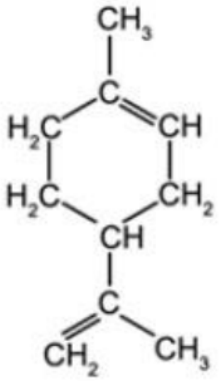
Chemicals in Panna Cotta

AS2.2 context for Sacred Heart College Lower Hutt

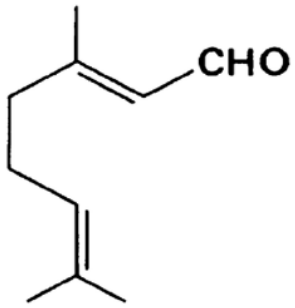


Structural Formulae for Organic molecules found in “7up Free”

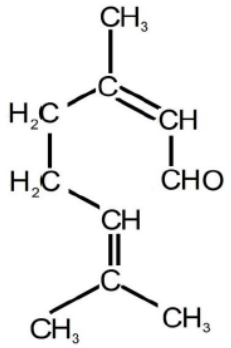
AS2.2 context for Wa Ora High School Lower Hutt



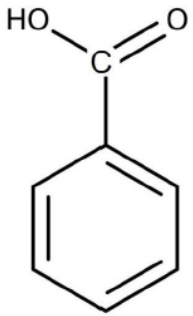
limonene



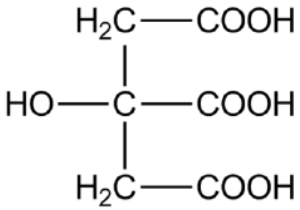
geranial



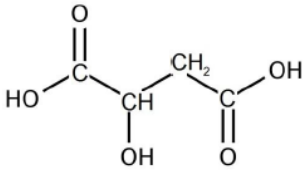
neral



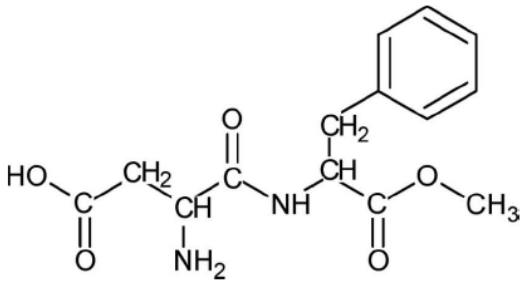
benzoic acid



citric acid

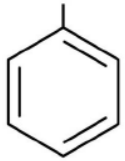


malic acid



aspartame

The following structure appears in two of the structural formulae on this page. It is called a phenyl group, C_6H_5-. Although it appears to contain C=C double bonds, the phenyl group *does not react with bromine water*.



ADVANTAGES

A quote from a teacher who has used AS2.2 organic unknowns in 2019

Students loved it. It fitted naturally with teaching organic chemistry. Took 2 more weeks than usual for organic. Massively helped students understand organic chemistry.