Titration Challenge!

Open to all Chemistry educators and laboratory technicians!

Can you titrate as well as your students? Here's your chance to find out.

The RACI is inviting Chemistry educators and laboratory technicians (secondary school and early years of university) to take part in the Titration Challenge. The RACI is the professional body for the chemical sciences in Australia. It acts as both the qualifying body in Australia for professional chemists, and as a learned society promoting the science and practice of chemistry. It represents and caters for the professional needs of the full range of chemists and those with an interest in chemistry, providing targeted activities and services that encompass the profession of Chemistry in Australia.

You will participate as an individual. With the permission of each entrant, a rank order of participants who achieve an Excellent result will be published on the RACI website,.

The analysis to be completed will be the same as that done by students in the Australian National Titration Competition Final **(see Details below).** Solid samples in small vials will be posted to you.

You will do the analysis in your own time at your own school. The closing date for submission of results to the ANTC National Coordinator (Elaine Bergmann see below for contacts) is the last day of school in Term 3.

Awards

- A plaque will be awarded to each of the top 10% of participants, providing that each of these has submitted a result of Excellent Standard (see Section 6 of the Rules).
- All others obtaining a result of Excellent Standard will receive a certificate recognising their achievement.
- The remainder will receive a Certificate of Participation.
- Please register online at least 2 weeks before you wish to complete the analysis as the coordinator needs sufficient time to weigh samples and post them to you.

Entry Fee $11.00 (payable online at time of registration)

Coordinator:

Elaine Bergmann (FRACI CChem)
Email: Titration@raci.org.au (preferred means of contact)

Mobile: 0408 877 942
Home: 07 4580 1711

Teachers and Laboratory Technicians Titration Challenge

Details

Section 1. Suggested Apparatus

- 1 x 25 or 50 mL burette (see Note 1.1)
- 1 x 20 or 25 mL pipette (see Note 1.1)
- 1 x 100 mL volumetric flask (see Note 1.2)
- 2 x 250 mL conical flasks
- 1 x 250 mL beaker
- 1 x 100 mL beaker
- conical funnel
- supply of filter papers (see Note 1.3 below)
- Pasteur pipettes
- glass rod
- retort stand and clamp, filter stand
- marking pens or labels
- pipette filler

Use of self-filling burettes or pipettes, pH meters, automatic titrators, and magnetic stirrers is not permitted. Filtration is by gravity (not suction).

NOTE: The RACI is aware that newer, modern designs and brands of pipettes and burettes have been developed, and they are actively marketed to schools and universities, as being safer for student use. If you intend to purchase new apparatus (or may have already done so recently), but are unsure if it meets the requirements of the RACI Titration Challenge, please contact the RACI National Titration Coordinator, Elaine Bergmann (FRACI CChem) by email: Titration@raci.org.au

In keeping with standard laboratory procedures, appropriate personal protective equipment should be worn by all participants.

Note 1.1: If a 25 mL burette is used, it is possible that it may require refilling during a titration if the pipette used is also 25 mL.

Note 1.2: If entrants wish to make up the Unknown solution in a second volumetric flask, they are free to do so, but any error in glassware volumes will cancel out only if the same burette, pipette, and volumetric flask are used for both Standard and Unknown Sample titrations.

Note 1.3: The barium sulfate in the Unknown Sample should be retained by Whatman #1 papers, provided that the filtration is carried out correctly.

Section 2. Chemicals

Each entrant will receive the following samples:

A sample tube (Standard Sample) containing 0.3000 - 0.5000 g of potassium hydrogen phthalate (KHP - formula mass 204.22) with a label giving the mass of sample (to 0.0001 g), the number of moles of KHP, and an identifying number (e.g. S152).

A sample tube (Unknown Sample) containing 0.3000 - 0.5000 g KHP mixed with barium sulfate (0.05 - 0.15 g) labelled with an identifying number (e.g. U154).

Check your samples when you receive them. Please alert the coordinator if there are any problems, and replacement(s) will be provided.

You will need to supply:

- wash bottle and supply of deionised/distilled water
- fresh phenolphthalein indicator solution
- a screw-cap or stoppered bottle containing approx. 300 mL sodium hydroxide solution, about 0.02 M.

Section 3. Procedure

Each entrant will analyse one Unknown Sample, after standardising the sodium hydroxide solution against the Standard Sample. Appendix 1 details the "Orthodox Procedure", although many variations on this procedure can also produce excellent results.

Section 4. Time limits

The analysis should be completed within 3 hours.

Section 5. Judging of Results

The challenge will be judged on the number of moles of potassium hydrogen phthalate submitted for judging.

Section 6. Calculating Scores

Each value will be rounded off to 4 significant figures, and then multiplied by 10^6. For example, result submitted is 2.1034×10^{-3} mol KHP. This becomes 2103. Similarly, the correct value is multiplied by 10^6. If this were 2.110×10^{-3} mol KHP, it becomes 2110. This (10^6 x correct value) is then subtracted from (10^6 x submitted value) to give (10^6 x deviation) or $10^6\Delta$. In this example, $10^6\Delta$ is -7.

If the absolute value of this number is 20 or less, the result is considered to be Excellent.

For example:

Name	Submitted Value	Correct Value	$10^6\Delta$	Individual Certificate
Bill Smith	2.103×10^{-3}	2.110×10^{-3}	-7	Excellent
Mary Jones	1.907×10^{-3}	1.886×10^{-3}	-21	Participation

Section 7. Awards

Each participant will receive a certificate as detailed in the table above.

The best performing 10% of entrants will receive a plaque commemorating their achievement, providing each of these is of an Excellent standard.

Section 8. Submitting your Results:

When you have done your analysis, calculate the number of moles of KHP in the Unknown Sample, and email the following information to the Coordinator: (contact details on Page 1)

- your name, school and postal address
- Unknown Sample Number
- your calculated number of moles of KHP in the Unknown Sample
- a copy of your Result Sheet.

Appendix 1: Orthodox Procedure (may be varied at your discretion, but must be obtained by titration)

Open the Standard vial (see Note A), and tip the contents into a beaker. Rinse remaining sample out of the tube into the beaker with distilled water, making sure none of the sample is retained in the lip of the vial, or on the inside of the cap. Add sufficient water to dissolve the sample (but less than 100 mL total) and stir using the glass rod, to dissolve the solid completely (alternatively, the sample could be transferred with the aid of a funnel into a conical flask, which is stoppered and shaken vigorously). When the sample has all dissolved, transfer to a 100 mL volumetric flask, and carefully make up to the mark. Stopper and mix well. Rinse the pipette with the acid solution and transfer 20 or 25 mL into a conical flask. Add phenolphthalein indicator.

Rinse the burette with some of the sodium hydroxide solution, then fill the burette (see Note B). Run the solution from the burette into the flask to a phenolphthalein end-point. For dilute solutions, it is important to titrate to a consistent indicator colour, preferably a pale pink that lasts for 10 seconds. Repeat the titration as often as time and solution volumes allow. Calculate the concentration of the sodium hydroxide solution.

Dissolve the KHP in the Unknown Sample in distilled water, and filter the solution to remove $BaS0_4$. The efficiency with which the paper is rinsed is important, but remember that the total volume of filtrate plus washings must not exceed 100 mL. Transfer the solution to a volumetric flask (rinsing to ensure that all of the dissolved acid is transferred to the flask) and make up as for the Standard. Pipette out aliquots, and titrate as you did for the Standard solution.

Note A: Sometimes it may happen that some of the material adheres to the lid of the vial, and may spill if it is opened. The KHP does tend to "cake" if the vial stands in a particular position for some time. Tapping the lid sharply before the bottle is opened may sometimes assist, but it should always be opened over a beaker or flask with a funnel in the neck, as spillages will then usually be contained. Remember always to rinse the lid as well as the inside of the vial.

Note B: If such a dilute sodium hydroxide solution is exposed to the atmosphere, absorption of carbon dioxide can significantly affect the concentration in a short time. A common “symptom” of this problem is that increasing volumes of the sodium hydroxide solution will be required to titrate the same volumes of acid solution.