



Queensland Branch Chemical Education Group

Qld Regional Chemical Analysis (Titration) Competition - 2013

THE COMPETITION

Your school is invited to enter teams from Grades 10, 11 and 12 in the Queensland Regional Titration Competition. There are four (4) Qld Regional Competitions held during the year.

S.E. QLD – Brisbane, Gold Coast, Toowoomba and Sunshine Coast Regional Competition	Refer Details below in this Document or Contact Ruth Meaney RACI Qld Coordinator	gld-raci@raci.org.au
Central Qld Regional Competition	Dr Vicky Vicente-Beckett (CQU Rockhampton Campus)	v.vicente-beckett@cqu.edu.au
Cairns Regional Competition	Dr Mike Liddell (JCU Cairns Campus)	michael.liddell@jcu.edu.au
Mackay Regional Competition	Mr Alun Tunnah (Mackay Christian College)	atunnah@mccmky.qld.edu.au

S.E.QLD VENUES AND DATES

Saturday, 11 May 2013 (max. 35 teams)	Griffith University, Nathan Campus Meet at Building N34 - 8.30am for Registration
Saturday, 18 May 2013 (max. 20 teams)	Griffith University, Gold Coast Campus Building G12 Science 2 – 8.30am for Registration
Saturday, 18 May 2013 (max. 50 teams)	Queensland University of Technology E Block Gardens Point Campus – 8.30am for Registration
Saturday, 18 May 2013 (max. 20 teams)	University of the Sunshine Coast Building H, Lab Room 1.04 – 8.30am for Registration
Saturday, 25 May 2013 (max. 100 teams - with a limit of 25 teams who do not bring their own apparatus) Note: Late entries will only be received for UQ if the school is bringing ALL their own apparatus.	University of Queensland, St Lucia Campus Chemistry Building 68 Cooper Road – 8.30am for Registration
Saturday, 25 May 2013 (max. 12 teams)	University of Southern Queensland, Toowoomba Campus Ground Floor W-Block, 9.00am for Registration and starting time 9.30am
Sunday 26 May 2013 (max. 12 teams)	St Saviour's College, Toowoomba Neil St, Toowoomba, 9.00am for Registration, starting time 9.30 am

At each venue (except Toowoomba), starting time for the competition is 9.00am, and registrations open at 8.30am. At Toowoomba, the starting time is 9.30am with the registration desk open from 9.00am.

NOTE:

For the benefit of schools in the Darling Downs / SW Qld Region - the competition is held at 2 venues with a total of 24 team places available for the region. You may nominate either venue on the entry form, but if the available places are all full, you may be asked to come to the alternative venue.

THE COMPETITION

The aim of the competition is to encourage students who enjoy Chemistry - especially practical Chemistry - and to recognise those who are becoming proficient. The Competition in Brisbane has been held annually since 1980, and since 1984 has been part of the Australian National Chemical Analysis Competition (as a Regional Competition). Leading teams in the Regional Competition are eligible to enter the Finals of the National Competition, to be held in the second half of the year (usually October). For the S.E Qld Region, a winner is announced for each venue and an overall winner for the Region (Brisbane, Gold Coast, Sunshine Coast and Toowoomba Competition).

Entrants compete in teams of three (3). Individual students may also compete, but they will not be eligible for the National Finals. Each member of each team performs a simple acid-base titration exercise (more details are outlined further over in this document). A NaOH solution is standardised against standard HCl. An "unknown" acetic acid solution is then titrated with the NaOH solution. Judging is on the basis of the values the team members report for the acetic acid concentrations.

We are grateful to the host Institutions for allowing us the use of their facilities, and to all the many individuals who volunteer to assist in any way.

CONDITIONS OF ENTRY

TEAMS

Because of the nature of the event, there are a number of restrictions at each venue, and we have to limit the number of teams from each school. In the Regional Competitions, there will be **a limit of four (4) teams overall**, from Grades 10, 11 and 12 in any combination (one team may, if you wish have entrants from more than one Grade). These may all be at one location, or spread over two or three venues. You do not have to have all your teams at the same venue. However, if you wish to bring more than four (4) teams, please enquire with Ruth Meaney (contact details on entry form). This will depend on entries already received for your preferred venue, and if any additional teams can bring all their own apparatus. (If there are vacancies at any venue one week prior to the competition date, extra spaces will be allotted on a first come – first served basis to schools who have requested more than 4 entries)

- If you have more than the maximum number of students who would like to enter, we encourage you to hold a competition within your school for the best titrators. When you enter teams you will be able to nominate the venue you prefer, but if the available places are all full, you may be asked to come to an alternative venue. We are placing no geographical restrictions on the venue where you participate (*i.e.* schools in the Gold Coast area may send teams to a Brisbane venue, and *vice-versa*). Places at each venue will be filled on a "first come" basis, so register early! Please try to be realistic with your estimate of number of teams participating. If you nominate more teams than actually turn up on the day, others may unnecessarily be turned away. **Please note that a student can come to one venue only, and any individual student may take part only once. An individual student may not do 2 titrations as a replacement for another team member that did not attend on the day.**

ENTRY FEES – PLEASE NOTE: PRICES QUOTED ARE GST INCLUSIVE

Entries will only be accepted if accompanied by the Entry Form, and will be taken in order of when we receive the entries.

NOTE:

- **A separate Tax Invoice will be issued to the school after receipt of the Entry Form, for payment of the Entry Fees.**
- **Payments will be accepted by EFT direct to the RACI nominated bank account. Details will be included on the Tax Invoice.**
- **A school will not be excluded if the payment has not been received by the RACI by their preferred venue date.**

Fees are \$33.00 per team (\$11.00 per student) except that, where the team brings "all glassware", there is a discounted fee of \$22.00 per team (\$7.70 per student). Please note that "all glassware" means all of the flasks, beakers, *etc.* listed in the Instructions below. There is no discount for teams who bring only their own pipettes and / or burettes, although there are obvious advantages for both you and us if you do bring your own, not least being that entrants can do the exercise on the apparatus they have practised with. We encourage as many entrants as possible to bring their own burettes and / or pipettes.

NOTE: To avoid lengthy queuing of teams on competition day and to facilitate the administration of the competition, entry forms and fees will not be accepted on the day at the venue.

PRIZES FOR BRISBANE AREA REGIONAL COMPETITION

1. **For Schools where Teams gain an "Excellent Team Performance":** A mounted plaque to be retained by the school and a certificate listing the names of the team members (for a definition of "Excellent Team Performance", see "JUDGING" below). The plaques and certificates will carry the appropriate inscriptions where a team has won a high place overall, or is a venue winner.
2. **For Each Member of Teams Placed 1-5 Overall, and of the Winning Team at Each Venue:** A mounted plaque to recognise the achievement.
3. **For the Leading Teams (at least the top two teams at each venue, and then the best performing teams overall, up to a total of approx. 10% of entrants):** The opportunity to enter the Finals of the Australian National Chemical Analysis Competition (see details below).
4. **For Each Individual who performs well (whether or not the team wins an award):** A merit certificate in one of the following categories: (Note: The Classification Nomenclature had been revised from 2012)

High Distinction	Result within 0.25%
Distinction	Result within 0.50%
Credit	Result within 0.75%
Competent	Result within 1.00%

- Competent will include all students with a Deviation of 10 or less even if their % difference is marginally above 1.00%
 - "Excellent Teams" will still be called "Excellent Teams"
 - In recent years, nearly 3/4 of entrants have received certificates of merit.
 - Certificates of Participation will also be sent for students that participated but did not receive a merit certificate.
5. **For Each Participating School:** A listing showing performance of each individual, with a ranking of teams competing at your venue, and a listing of results of "Excellent Teams".

We believe strongly that achievement in areas such as this should be recognised in schools and in the community as much as achievements in areas such as sport. If possible, we would like the opportunity to present prizes for "Excellent Team Performances" at a school assembly or similar event.

MATERIALS

Full details of the analysis exercise are attached. For those schools bringing "all your own glassware", the relevant items are asterisked on the list of equipment given there. Entrants are encouraged to bring their own burettes (50 or 25 mL - any tap design but not "self-filling") and/or pipettes (25 or 20 mL), but these will be supplied by us if this is not possible. **Self-filling and digitally reading pipette fillers are not permitted.** If a 25 mL burette is used, a 20 mL pipette is advisable; otherwise, refilling of the burette may be necessary. Entrants sometimes bring two different pipette sizes, for HCl and acetic acid. Our experience has been that almost invariably such students become confused and miscalculate.

Entrants may bring, if they wish, tea towels for wiping apparatus, cards or magnifiers to facilitate reading of burettes, white tiles to assist in detection of end point, *etc.* Use of pipette fillers is encouraged. **Venues cannot supply pipette fillers so if used they must be brought from the school. (See note on safety below.)** Pocket calculators or other aids to calculation may be brought, along with pens, paper for rough working, written notes, *etc.*

RISK ANALYSIS

The titration operation involved in this competition is not inherently high risk. However, precautions should be employed to minimise the low level of risk still further.

1. Use of Apparatus

- By far the highest risk is in the improper use of pipette fillers, as, if the pipette is inserted while held by the stem far from the filler, the pipette may break and cause serious injury to the hands.
- **IT IS ESSENTIAL THAT ALL STUDENTS BE THOROUGHLY TAUGHT THE CORRECT WAY TO USE A PIPETTE FILLER.**
- Pasteur pipettes can potentially cause injury to another person if waved through the air. This should never happen. Serious injury would occur only if an eye was struck, and safety glasses should prevent this.
- It is possible that any other of the glass apparatus may break and cause minor cuts. Clamping a burette too tightly may cause it to snap. Apparatus dropped on the floor will break, and minor cuts are possible. Students should be instructed not to attempt to clean up broken glass themselves, but to ask one of the assistants at the competition to do this.

2. The Solutions

- Acid and base solutions provided are approx. 0.1 M. This is too dilute to cause skin damage if spilled on the skin. If spilled on clothing and not rinsed off it may eventually cause holes to form in the cloth. Any spills on skin or clothing should be rinsed off immediately. If any splashed on the eyes (which should be prevented by safety glasses), it would sting but there would be no lasting damage if rinsed away rapidly. If any of the solutions were to enter the mouth (unlikely if pipette fillers are used), the taste would be unpleasant, but again no tissue damage would occur. The mouth should be rinsed, and if solutions were swallowed, copious water should be drunk.

SAFETY

While the hazards of handling solutions at the concentrations used in this competition are low, teachers should take the time to instruct students on the safe use of these chemicals and to also ensure that all solutions and chemicals (including indicator solutions) are labelled correctly including any safety handling procedures and potential hazards. Instruction on the safe use of pipettes, burettes and other glassware is also important. **When students are using pipette fillers, ensure that they are taught the correct procedure for inserting pipettes into fillers as this presents possibly the greatest hazard in the competition. Mouth pipetting is not permitted.**

PLEASE NOTE IT IS THE RESPONSIBILITY OF EACH SCHOOL TO PROVIDE THEIR OWN STUDENTS WITH PIPETTE FILLERS AND SAFETY GLASSES. STUDENTS MUST WEAR FULLY ENCLOSED FOOTWEAR AND SAFETY GLASSES AT ALL TIMES, AND IT IS RECOMMENDED THAT STUDENTS WEAR LAB COATS AT ALL TIMES (SOME VENUES MAY REQUIRE LAB COATS AS COMPULSORY).

ENTRY PROCEDURE

To enter one or more teams:

1. Fill out the enclosed Entry Form and forward to Mrs Ruth Meaney – Qld Coordinator
 - By Mail:- PO Box 667, Mt Gravatt, Qld, 4122
 - By Fax:- (07) 3420 4223
 - Scan and Email: qld-raci@raci.org.au
2. After receipt of the Entry Form by the RACI, a Separate Tax Invoice will be issued to the School for Payment of the Entry Fees.
3. A School will not be excluded if payment has not been received by the RACI by the due date.

Entries should be sent as soon as possible, but not later than two (2) weeks before the competition at your preferred venue. Telephone and email entries will not be accepted unless an entry form is subsequently sent within 5 working days. There is no need to send names of individual entrants at this stage. Please ask for your Principal's permission to take part. All entries received by the due date will be acknowledged by return email, and details of the competition venue will be forwarded. We cannot guarantee a place at any venue for teams whose entry forms are received after the due date, but late entries will continue to be accepted up to the time of the competition if space is available. All inquiries regarding availability of places and entry details should be directed to Mrs Ruth Meaney see above. Queries about the National Finals may be directed to Dr T G Appleton, Email: tappleton44@optusnet.com.au

REGISTRATION AND INSTRUCTIONS ON COMPETITION DAY

Please double-check the venue and date of your entry. The registration table will be open at each venue at approximately 8.30 am (Toowoomba 9.00am). There is no advantage for teams to arrive much earlier. Once a team has all its members and all the equipment they are bringing, the members should follow the signs displayed to register. They will then be ushered to a laboratory space where each member will receive an instruction sheet and a result sheet (similar to those enclosed). They will have **one and a half hours** (90 minutes) to complete all titrations, carry out all calculations, and hand in result sheets. Entrants may carry out as many titrations as time and solution volumes allow. They may, if they wish, bring any special instructions from teachers, including calculation methods. Allowances for breakage and accidental spillage will be at the discretion of the venue adjudicator. Students within a team may discuss methods and results freely. Whether or not entrants wear school uniform is at their discretion, or that of the school. However, fully enclosed footwear and safety glasses must be worn at all times, and lab coats are recommended.

We anticipate that we will be able to announce the winning teams (**provisional until all results have been further checked**) at each venue within a few minutes of the last team handing in results. We will supply light refreshments for entrants after they have finished their titrations. A full listing of all results will be sent to all participating schools with any certificates earned. It is anticipated all results will be emailed as a PDF directly to the teachers by the end of August, depending on the number of teams participating, and the certificates will be mailed just after that for schools to receive them by the end of Term 3. This will still allow the top teams preparation time for the National Finals in October.

Teachers are encouraged to accompany their teams. Once the competition begins, you will not be allowed to talk with them or "look over their shoulders", but you can look on from a distance. Tea and coffee will be provided.

JUDGING

Judging will be entirely on the basis of the calculated molarity of the acetic acid solution. This should cause errors due to uncalibrated glassware, traces of carbonate, *etc.* to cancel out. Correct titration volumes but incorrect calculations will cause the team to miss any chance of an "Excellent Performance". Calculated molarities of the winning teams will be checked against titration volumes to ensure against the slight possibility that poor arithmetic has compensated for poor titration.

For each member of a team, the difference between the correct concentrations of the acetic acid sample (determined by experienced titrators at each venue) will be calculated. This difference will be squared to give the variance. The team with the lowest sum of variances for the three acetic acid solutions is the winner. For an "Excellent Team Performance", the sum of variances will be less than 3.3×10^{-7} . **Teams are advised to report results to four (4) decimal figures.** While the adjudicator would encourage discussion from entrants or their teachers about any difficulties encountered that may affect results, a condition of entering the competition is that the adjudicator's ultimate decision is final

INSTRUCTIONS TO TEAM MEMBERS

(A copy of these instructions is given to each team member before commencement of the competition)

1. A team should approach the Registration Desk only when all its members have arrived, and it has all of the apparatus they are bringing. On registration, a team should receive an identification tag, and a card showing the location assigned to that team in the laboratory. Ushers will take the team to that location.
2. When you arrive at this location, place the identification tag at the end of your team's work area.
3. Check the labels on sodium hydroxide and acetic acid bottles in front of you. You should have a set A, B, or C for each member of your team.
4. **PLEASE PRINT YOUR NAME CLEARLY on the Result Sheet at the end of these instructions, as this is how your name will be printed on any certificates and plaques awarded to you.**
5. Indicate on the form which set of solutions you have - A, B, or C. Do not swap solutions after this with any other team member.
6. Check that your team has the following (one per team):
Solution of Hydrochloric Acid
Phenolphthalein Indicator Solution
7. Each Team Member should have the following. Where a team brings all its own glassware (to qualify for a discounted entry fee), the items to be brought are asterisked: (You may bring your own burette and pipette, even if you do not bring all other glassware)

- **Report any problems to a supervisor.**

Solution of Sodium Hydroxide (A, B, or C)

Solution of Acetic Acid (A, B, or C to match NaOH)

Dropper and Bulb

***Two Conical Flasks or Beakers for the titration**

***Two Small Beakers for filling burette or pipetting solutions**

Small funnel for filling burette

***Washbottle (distilled water is available in the laboratory but please use sparingly, or we may run out!)**

***25 or 20 mL pipette**

***25 or 50 mL burette**

**(Pipette Fillers)
(Safety Glasses)**

**(Please Note: It is the responsibility of each school to provide
their own students with pipette fillers and safety glasses)**

8. Before the competition begins, you should rinse your apparatus with distilled water. Check that your burette does not leak, and is not blocked. Check that the tap turns freely. Detergent solution is available, if you wish to rinse burettes or pipettes with it. Report any problems to a supervisor.

DO NOT TOUCH THE SOLUTION BOTTLES UNTIL YOU ARE ADVISED TO DO SO.

9. Some stools and wooden boxes are available, if required.
10. Your teacher, parents, or friends may speak with you up to the commencement of the competition. Once you have been told to begin, **THERE MUST BE NO COMMUNICATION WITH ANYONE OUTSIDE YOUR TEAM, EXCEPT A SUPERVISOR, UNTIL YOUR RESULT SHEET HAS BEEN SUBMITTED.**

11. From the time you are told to start, you have 90 minutes to complete all titrations and calculations and to complete the Result Sheets. You will be given about ten minutes warning before the end of your time.
12. Pipette 20 or 25 mL hydrochloric acid into a flask or beaker. Add a few drops of indicator solution. Run in sodium hydroxide solution from the burette to the pink end point. Note the volume on your Result Sheet. You may repeat as often as time and solution volumes allow.

Do the same with the acetic acid. Calculate concentrations of sodium hydroxide and acetic acid solutions.

13. The volumes of solutions supplied should be sufficient to allow the titrations to be carried out if there are no major accidents. If there are breakages or spillages, report them to a supervisor. In some circumstances, solutions or apparatus may be replaced. First Aid kits are available. The organisers accept that there could be a slight chance of a mislabelled bottle or other solution mix-up. If you think there is any problem with your solutions, please bring it to the attention of a supervisor as soon as you are aware of the problem.

Supervisors may at their discretion supply additional solutions if you simply “run out”. However, you should be aware that a replacement NaOH solution could lead to inaccuracies because of the tendency of NaOH solutions to absorb atmospheric CO₂. Slight leakage of CO₂ into the bottle around the cap, then into the solution will not be a problem as long as the same solution is used for standardisation and analysis of acetic acid, but might be a problem if the solutions were from different bottles.

14. In some laboratories, conditions may be a little crowded, so please consider teams around you as you work. Should there be any deliberate interference with neighbouring teams; the offending team will be immediately disqualified.
15. Make sure you leave enough time after your titrations to carry out and check your calculations. Remember that a calculation error deprives you of any chance of winning a prize. You may discuss your results freely within your team. Write your calculated concentrations on the Result Sheet (to four (4) decimal figures). Check that you have not made a mistake in transferring this number from your calculations. Be especially careful with the decimal point. If your answer lies outside the range 0.08 to 0.13 M, you have made a mistake! You may use calculators or other aids for calculation, and refer to any written material you may bring.
16. Put the three Result Sheets from your team together, **IN ORDER, A, B and C, WITH A ON TOP**. The correct concentrations will be announced after the competition. You may wish to write down your own result on a sheet of paper before you hand in the Result Sheet, for comparison. **Remember to hand in all the results sheets at the end of the competition. Failure to do so will mean your results will not be included for the Awards and issuing of Certificates etc**
17. Rinse your apparatus with water, and follow any other directions of supervisors regarding cleaning up, etc. Be sure to take with you all apparatus belonging to you or your school.
18. Refreshments are available at the advertised location. Provisional announcement of results will be made as soon as possible after the competition is finished. Final results will be sent to schools after forms have been fully checked.
19. We hope you enjoy being part of the competition.

TITRATION COMPETITION - RESULT SHEET

VENUE..... DATE.....

STUDENT
NAME.....

PLEASE PRINT FULL NAME CLEARLY (this name will be printed on certificates)

SCHOOL.....

TEAM No. GRADE.....
(As on identification tag)

You have been allocated solutions: **A** or **B** or **C** (circle one)

MOLARITY OF HCl Solution Provided

0. _____ **M** (given)

Titration of Standard HCl (mL) with NaOH solution (Students to complete this section)

Volumes of NaOH for individual titrations (place X against any you have ignored for subsequent calculations)

Average volume ----- mL

Calculated NaOH Molarity ----- M (Students to complete this section)

Titration of Acetic Acid (mL) with NaOH solution (Students to complete this section)

Volumes of NaOH for individual titrations (place X against any you have ignored for subsequent calculations)

Average volume ----- mL

Calculated Molarity of Acetic Acid solution ----- M

Student Signature.....

CHECK ALL SECTIONS HAVE BEEN COMPLETED.

- Put the three Result Sheets from your team together, IN ORDER, (A), (B) and (C), WITH (A) ON TOP.
- Staple the team sheets together.
- Remember to hand in all the results sheets at the end of the competition.

You may use the back of this sheet for rough work calculations.