

THE ROYAL AUSTRALIAN CHEMICAL INSTITUTE INCORPORATED
Chemistry serving Australia

TITRATION STAKES 2013

INSTRUCTIONS TO TEAM MEMBERS

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

INTRODUCTION

The Vinegar and Pickle factory wants to develop a new range of products based on dilute vinegar solutions. Your job is to determine the acetic acid (vinegar) concentration of the samples taken from the production line. You have a solution of hydrochloric acid of known concentration, a solution of sodium hydroxide solution of unknown concentration and the sample of acetic acid. You will determine the concentration of the acetic acid in two stages. First, you will determine the concentration of the sodium hydroxide solution you have been given in a titration experiment using an accurately known volume hydrochloric acid. Then you will determine the concentration of the acetic acid solution in another titration experiment using the sodium hydroxide solution. To get an accurate answer, you will need to do the experiments three or four times – the first one in each case can be treated as a “sighter” experiment – to get a rough idea of the volumes required. The results of the next titrations should get you closer and closer to the correct result.

INSTRUCTIONS

Before you start, ensure that each member of your team is wearing appropriate protective clothing (safety glasses, lab coat and enclosed shoes)

1. Check that your team has three bottles of hydrochloric acid (which are all identical) three bottles of sodium hydroxide solution labelled A,B and C and three bottles of acetic acid labelled A, B and C. One member of your team should conduct experiments on the A bottles, one should use the bottles marked B and the third member of the team should carry out experiments on the bottles marked C.
2. **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.
3. 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.
4. Check that your team has the following (one per team):

Phenolphthalein Indicator Solution

5. Each Team Member should have the following.

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

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

Solution of Hydrochloric Acid

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**

***25 or 20 ml pipette**

***50 ml burette**

Pipette Fillers

6. Before the competition begins, you should rinse your apparatus with distilled water. Check that your burette does not leak, and is not blocked.

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

7. 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.**
8. 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.
9. Carefully transfer your sodium hydroxide solution into the burette: be careful not to over-fill the burette and ensure that you read the level accurately.
10. 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. Remember to top up the burette after each titration!
11. Then into a clean flask or beaker, pipette 20 or 25 ml of acetic acid solution, add a few drops of indicator and run in the 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.
12. Calculate the 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.
14. Make sure you leave enough time after your titrations to carry out and check your calculations. You may discuss your results freely within your team, but remember that A, B and C are likely

to be quite different. 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.

15. Put the three Result Sheets from your team together, **IN ORDER, A, B and C, WITH A ON TOP.**
16. Rinse your apparatus with water, and follow any other directions of supervisors regarding cleaning up, etc.
17. We hope you enjoy being part of the competition: the vinegar and pickle factory is very grateful for your assistance!

RESULT SHEET

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

STUDENT NAME.....
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 B C (circle one)

MOLARITY OF HCl Solution Provided 0. M (given)

Titration of Standard HCl (.... ml) with NaOH solution (please 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 (please complete this section)

Titration of Acetic Acid (.... ml) with NaOH solution (please 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

Signature.....

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

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.
Remember to hand in all the results sheets at the end of the competition.**