

## Using digital badges for developing high-school chemistry laboratory skills

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Supplementary Information:

Peer review sheets for:

- (1) Standard Solution Procedure
- (2) Pipetting Procedure
- (3) Titration Procedure

Competency Requirement Details for each badge (information added to badge metadata in [www.credly.com](http://www.credly.com))

- (1) Standard Solution
- (2) Pipetting
- (3) Titration

## Standard Solution Procedure Review Sheet



Name:

Partners Name:

**Instructions:** Use the spaces to highlight relevant points and ask your partner offer some helpful feedback when reviewing the technique.

Protocol Step		<input checked="" type="checkbox"/>	Your Comments / Feedback Lab Partner
1	<b>Weighing out solid sodium carbonate into weigh boat</b> <i>To check: clean balance, tare the balance with the weigh boat,, tidy working, final mass close to required value.</i>		
2	<b>Transferring solid to beaker</b> <i>To check: adding solid from weigh boat and washing weigh boat into beaker, aid dissolving with glass rod, washing glass rod, taking care not to exceed final desired volume.</i>		
3	<b>Transfer to volumetric flask</b> <i>To check: transfer of solution, raising the funnel, washing of beaker and bringing final volume close to mark.</i>		
4	<b>Making up to the mark</b> <i>To check: careful addition of water dropwise using a plastic pipette, bottom of meniscus exactly on graduation line. Stoppering and inverting solution. Adding a label with appropriate details.</i>		
<i>If the liquid level goes above the meniscus, the solution should be discarded and the procedure restarted.</i>			



## Pipetting Procedure Review Sheet

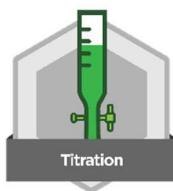
Name:

Partners Name:

**Instructions:** Use the spaces to highlight relevant points and ask your partner offer some helpful feedback when reviewing the technique.

Protocol Step		<input checked="" type="checkbox"/>	Your Comments / Feedback Lab Partner
1	<b>Collect the necessary glassware and ensure it is clean</b> <i>To check: washing of glassware with water and small amounts of solution. Drying off any drops.</i>		
2	<b>Pipette 25 cm<sup>3</sup> vinegar into 250 cm<sup>3</sup> volumetric flask or conical flask</b> <i>To check: filler is depressed prior to attaching to pipette; attaching with hands close together; drawing up liquid into pipette but not into filler; remove filler with index finger over the end of the pipette, lowering to the line; releasing liquid while holding pipette vertically, touch last drop to surface of solution.</i>		

## Titrations Procedure Review Sheet



Name:

Partners Name:

**Instructions**

Use the form below to assess your lab partner while they carry out a technique. Record the steps indicated on their phone so they can submit their video for assessment. Use the spaces to offer some helpful feedback when reviewing the technique. Submit this form to your demonstrator at the end of the lab.

	Protocol Step	☑	Your Comments / Feedback Lab Partner
1	<b>Collect the necessary glassware and ensure it is clean</b> <i>To check: washing of glassware with water and small amounts of solution. Drying off any drops.</i>		
2	<b>Pipette 25 cm<sup>3</sup> ~0.1mol dm<sup>-3</sup> sodium carbonate standard solution into flask</b> <i>To check: filler is depressed prior to attaching to pipette; attaching with hands close together; drawing up liquid into pipette but not into filler; remove filler with index finger over the end of the pipette, lowering to the line; releasing liquid while holding pipette vertically, touch last drop to surface of solution.</i>		
<i>Begin videoing the demonstration at this point</i>			
3	<b>Adding ~ 0.05 and 0.15 mol dm<sup>-3</sup> sulfuric acid, to the burette</b> <i>To check: holding funnel above burette, do not add to zero mark, removing funnel.</i>		
4	<b>Stating initial volume of liquid (camera zoom)</b> <i>To check: clear picture of initial value and stating reading to two decimal places.</i>		
5	<b>Adding indicator and beginning titration</b> <i>To check: adding 2 – 3 drops <u>only</u> methyl orange, presence of white tile, adding titrant while shaking flask, noting rate of colour change.</i>		
6	<b>Adding liquid dropwise towards end point</b> <i>To check: adding dropwise, washing burette tip and sides of flask with small amounts of water, successfully reaching end-point.</i>		
7	<b>Stating final volume of liquid (camera zoom) and note on sheet</b> <i>To check: clear picture of final value and stating reading to two decimal places; stating titration volume.</i>		
<i>End videoing the demonstration at this point</i>			



- Title  
A level Lab Skill: preparing standard solutions
- Description  
To have been awarded this badge you must have successfully completed the process outlined below:
  - Complete the pre-lab questions based upon the video <http://bit.ly/skillsstandardsoln>
  - Carry out the procedure and with a partner, take turns to using your phones to record each other completing the steps identified below.
- Successfully complete the calculation for your solution giving a final concentration to the appropriate degree of accuracy and answer the follow up questions.
- Watch the video of your technique and use the sheet provided below to assess yourself when watching the video. Ask your partner to review the video and add their comments to the sheet.

#### Criteria

- ✓ Collect the necessary glassware and ensure it is clean including washing of glassware with water and small amounts of solution. Drying off any drops.
- ✓ Weighing out solid into weigh boat: Adding solid from container to beaker while on tissue, moving to balance to weigh, tidy working, final mass close to required value.
- ✓ Transferring solid to beaker: Adding solid from weigh boat and washing weigh boat into beaker, aid dissolving with glass rod, washing glass rod, taking care not to exceed final desired volume.
- ✓ Transfer to volumetric flask: Transfer of solution, washing of beaker and bringing final volume close to mark. Making up to the mark
- ✓ Careful addition of water dropwise using a plastic pipette, bottom of meniscus exactly on graduation line. Stoppering and inverting solution



- ✓ Title  
A level lab skill: pipetting
- ✓ Description  
To have been awarded this badge you must have successfully completed the process outlined below:
  - Complete the pre-lab questions based upon the video <http://bit.ly/skillsvolpipette>

- Carry out the procedure and with a partner take turns to using your phones to record each other completing the steps identified below.
- Successfully complete the calculation for your final solution giving a final concentration to the appropriate degree of accuracy and answer the follow up questions.
- Watch the video of your technique and use the sheet provided below to assess yourself when watching the video. Ask your partner to review the video and add their comments to the sheet.

✓ **Criteria**

✓ Collect the necessary glassware and ensure it is clean including washing of glassware with water and small amounts of solution. Drying off any drops.

✓ Pipette 25 cm<sup>3</sup> stock solution into 250 cm<sup>3</sup> volumetric flask

Including these points:

✓ filler is depressed prior to attaching to pipette; attaching with hands close together; drawing up liquid into pipette but not into filler; remove filler with index finger over the end of the pipette, lowering to the line; releasing liquid while holding pipette vertically, touch last drop to surface of solution.

Title

A level lab skill: titrating



• Description

To have been awarded this badge you must have successfully completed the process outlined below:

- Complete the pre-lab questions based upon the video <http://bit.ly/skillstitrating>
- Carry out the procedure and with a partner, take turns to using your phones to record each other completing the steps identified below.
- Identify and use concordant titres to successfully complete the titration calculation giving a final concentration to the appropriate degree of accuracy and answer the follow up questions.
- Watch the video of your technique and use the sheet provided below to assess yourself when watching the video. Ask your partner to review the video and add their comments to the sheet.

• Criteria

- ✓ Collect the necessary glassware and ensure it is clean, including, washing of glassware with water and small amounts of solution. Drying off any drops.
- ✓ Pipette  $25\text{ cm}^3$   $\sim 0.1\text{ mol dm}^{-3}$  sodium carbonate standard solution into flask  
Including the following
- ✓ check filler is depressed prior to attaching to pipette; attaching with hands close together; drawing up liquid into pipette but not into filler; remove filler with index finger over the end of the pipette, lowering to the line; releasing liquid while holding pipette vertically, touch last drop to surface of solution.
- ✓ Adding  $\sim 0.05$  and  $0.15\text{ mol dm}^{-3}$  sulfuric acid to the burette  
Including:
- ✓ holding funnel above burette, do not add to zero mark, removing funnel and checking for air bubbles below the tap.
- ✓ Stating initial volume of liquid
- ✓ Recording the stating reading to two decimal places.  
Adding indicator and beginning titration
- ✓ Adding 2 – 3 drops only methyl orange, presence of white tile, adding titrant while shaking flask, noting rate of colour change.
- ✓ Adding liquid dropwise towards end point
- ✓ Including: adding dropwise, washing burette tip and sides of flask with small amounts of water, successfully reaching end-point.
- ✓ Stating final volume of liquid
- ✓ Record final value to two decimal places and calculate the titre.
- ✓ Complete a rough titration followed accurate titrations to produce two concordant results no further than  $0.1\text{ cm}^3$  apart.