Appendices

Appendix 1: Task 1 student worksheet

GCSE Neutralisation Task 1

NAME_____

_____

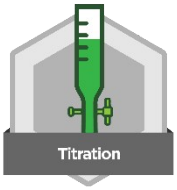
Task 1: Pre-Laboratory Exemplar Video and Questions

Badging Lab Skills

Digital badges are an increasingly significant tool for identifying and validating skills, knowledge and competencies that cannot be effectively assessed by exams. The purpose of this process is to:

- *Introduce students to correct procedure for core lab skills*
- *Emphasise the nature of correct technique*
- *Get students talking, explaining scientific technique*

For homework you have been asked to watch the video Titration: http://bit.ly/skillstitrating and have been told that there will be a short quiz about the video before you carry out this technique. I will ask you and your partner to take turn carrying out the technique and filming each other so that you can review and develop your laboratory skills.



To be awarded a badge you must successfully complete the process outlined below:

Task 1: Watch the exemplar video http://bit.ly/skillstitrating complete the pre-lab questions

Task 2: Carry out the procedure and with a partner, take turns to watch each other completing the steps identified below (you may use your phones to record these steps).

Task 3: Be able to identify and use concordant titres to successfully complete the titration calculation giving a final concentration to the appropriate degree of accuracy.

Task 4: Review your experience carrying out this procedure, identify areas of difficulty and ask your partner to give their opinion. If you have recorded the procedure use this to help you review your technique.

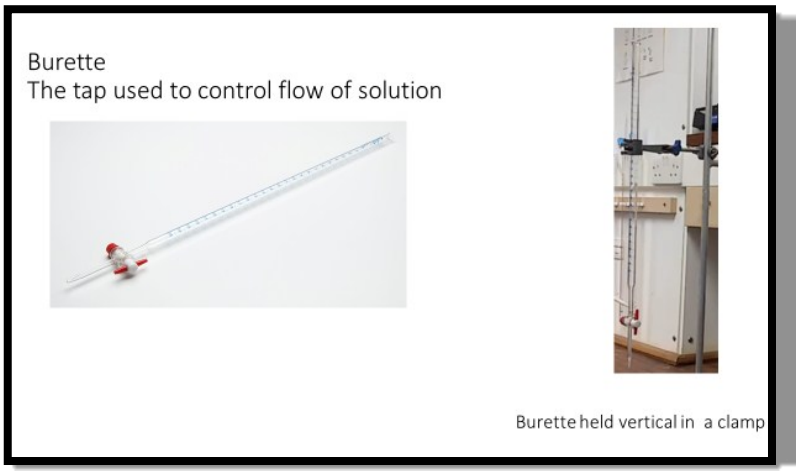
Titration Laboratory Skills are:

- **carry out a titration between hydrochloric acid and sodium hydroxide**
- **accurately read the volume on a burette to 2 decimal places the second being either a 0 or 5**
- **calculate a titre**
- **identify concordant results.**
- **calculate an average titre from concordant**
- **describe how an indicator can be used to determine the end point**
- **explain how accuracy can be improved in a titration**
- **recall the main steps involved in the practical procedure.**

Pre-laboratory Questions

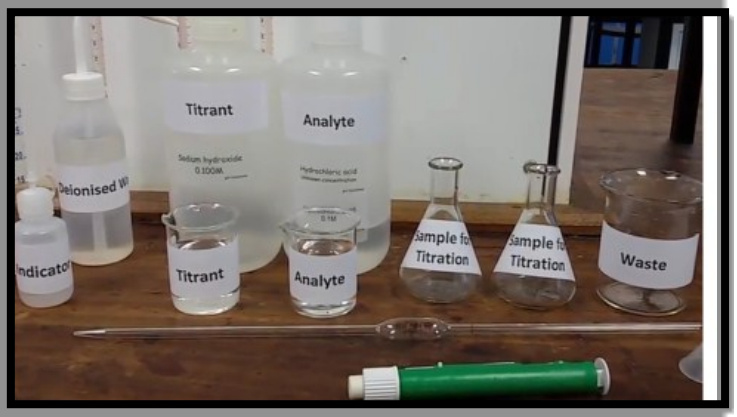
1. The top of the burette reads 0cm^3 down to 50cm^3 near the tap at the bottom. What is unusual about this?

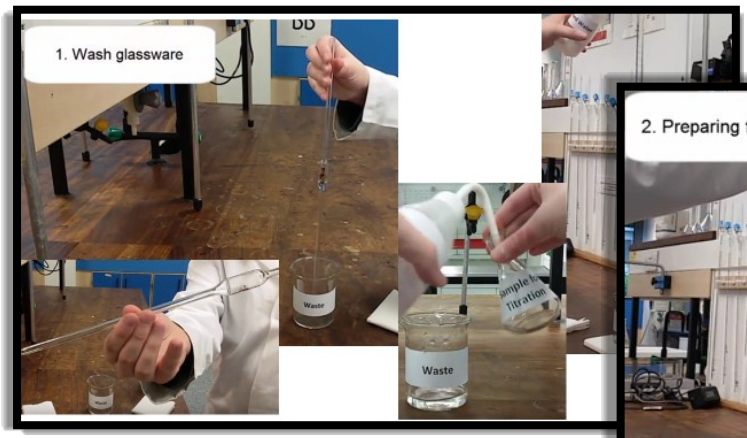
2. Why do you think it is like this?

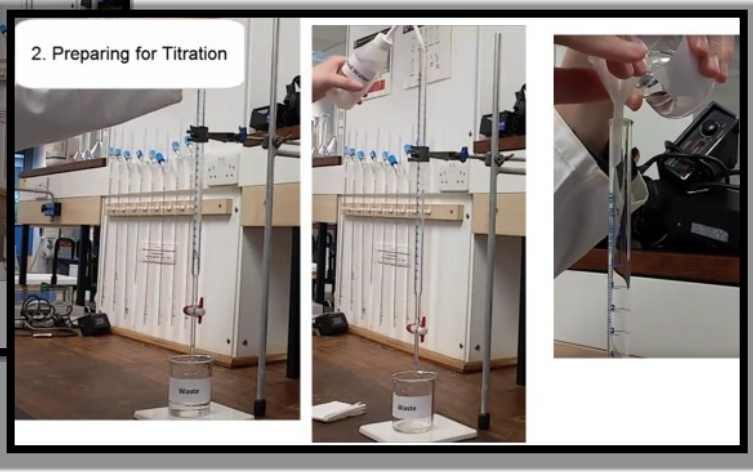


3. The difference between the starting volume and end volume recorded from the burette is called a titre. Calculate the titre if the burette starts at 1.05 cm^3 and ends at 23.70 cm^3?

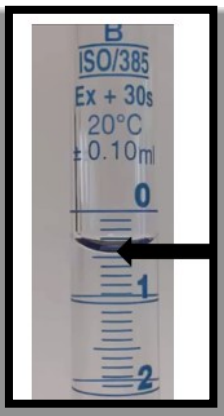
4. Which 2 solutions will go into the conical flask?







5. Give two reasons why the glass ware is rinsed with distilled water and then the reagent?

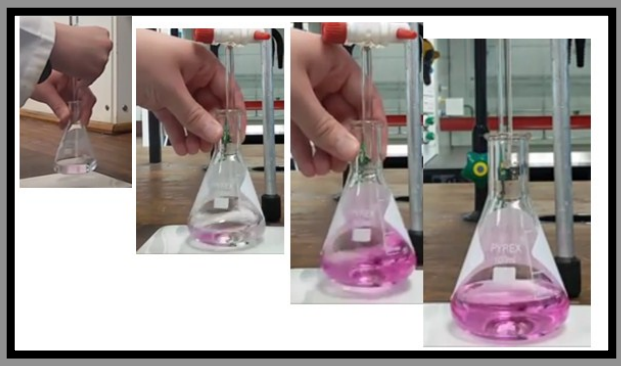


6 a. What is the name given to the “smile” at the top of the liquid in the burette?

6 b. What is the reading on this burette to one decimal place?

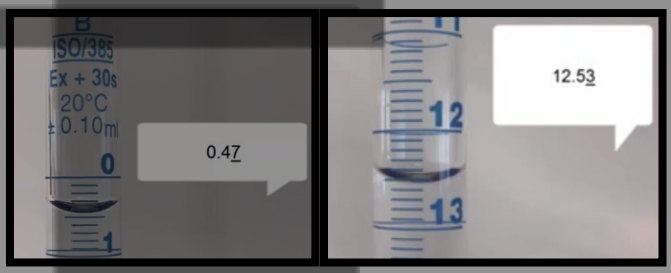
7. What is the name given to the first titration before the accurate titrations are carried out?

8. Why does the pink colour appear at the top of the solution in the flask but disappear as soon as the flask is swirled?



9. As the volume of acid delivered by the burette approaches that of the rough titre it is important to rinse the tip of the burette and wash the sides of the flask. A colour change has occurred because of this washing why?

10. What is the titre?



11. Which units are used in calculations involving this titre?

12. When the colour change begins to persist you are nearly at the end point. To make sure you don't add too much solution from the burette it is vital that you wash round the conical flask and tip of the burette (see Q9). If you add too much solution from the burette would your calculated concentration be too high or too low?

Appendix 2: Experimental methods

1. Neutralisation: determination of the concentration of solutions in mol/dm3 from the reacting volumes and the known concentration of the other solution

Place sodium hydroxide of unknown concentration in conical flask using graduated pipette and filler add 2-3 drops of phenolphthalein indicator. Titrate with dilute hydrochloric acid of known concentration from burette. Repeat and calculate mean titre and concentration of alkali.

2. Crystallisation: preparation of pure dry copper sulfate crystals

Preparation of a pure, dry sample of a soluble salt from insoluble oxide, using a Bunsen burner to heat dilute acid and a water bath to evaporate the solution. Completed by all three groups following traditional practical work pedagogy.

Appendix 3: Task 2 student worksheet

GCSE Neutralisation Task 2 Collecting Data

Name_____

0.100 mol/dm^3 hydrochloric acid: IRRITANT Sodium hydroxide solution concentration unknown: IRRITANT You must wear goggles

Introduction

1. A titration is a technique used to find the exact volumes of acid and alkali that react together. The point at which the acid and alkali have reacted completely is called the _____(A) ___of the reaction. We judge when this point is reached by using an ___(B) ___ which changes colour at the endpoint.

The equation for the reaction is: $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$

The indicator used in this titration is phenolphthalein: it is colourless in acid and pink in alkali.

The concentration of sodium hydroxide in mol/dm^3 and g/dm^3 can then be calculated from the reacting volumes and the known concentration of the hydrochloric acid.

1 A_____

1 B_____

2. Results Table

Titration	**Rough**	**Accurate 1**	**Accurate 2**	**Accurate 3**
Start Volume (cm^3)				
End Volume (cm^3)				
Volume Added (cm^3)				

3. The indicator used in this titration is phenolphthalein: it is colourless in acid and pink in alkali. In your experiment you watched pink solution become a colourless solution, many chemists prefer to use a colourless solution that becomes pink, as this is a more striking change (as demonstrated by the exemplar video). How could you rearrange your experiment so that the indicator in the conical flask begins colourless and as the burette delivers solution it gradually becomes pink?

4. Calculation

$$HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$$

So 1 mole HCl reacts with 1 mole NaCl

Hydrochloric acid			*equals*	Sodium hydroxide		
Concentration ($mol/dm^{3)}$)	*times*	Volume ($dm^{3)}$)	*(*moles)	Concentration ($mol/dm^{3)}$)	*times*	Volume ($dm^{3)}$)

Calculate your mean titre from 2 concordant results.

Convert your mean titre from centimetres cubed to decimetres cubed (divide by 1000)

Put the value in the table below

	Hydrochloric acid	Sodium hydroxide
Volume ($dm^{3)}$)		0.025
concentration ($mol/dm^{3)}$)	0.100	

Concentration of Sodium hydroxide ($mol/dm^{3)}$ is? _____

Partners Name: _____

GCSE Neutralisation Peer Observation Checklist

Instructions

Use the form below to assess your lab partner while they carry out a technique. Use the spaces to offer some helpful feedback when reviewing the technique.

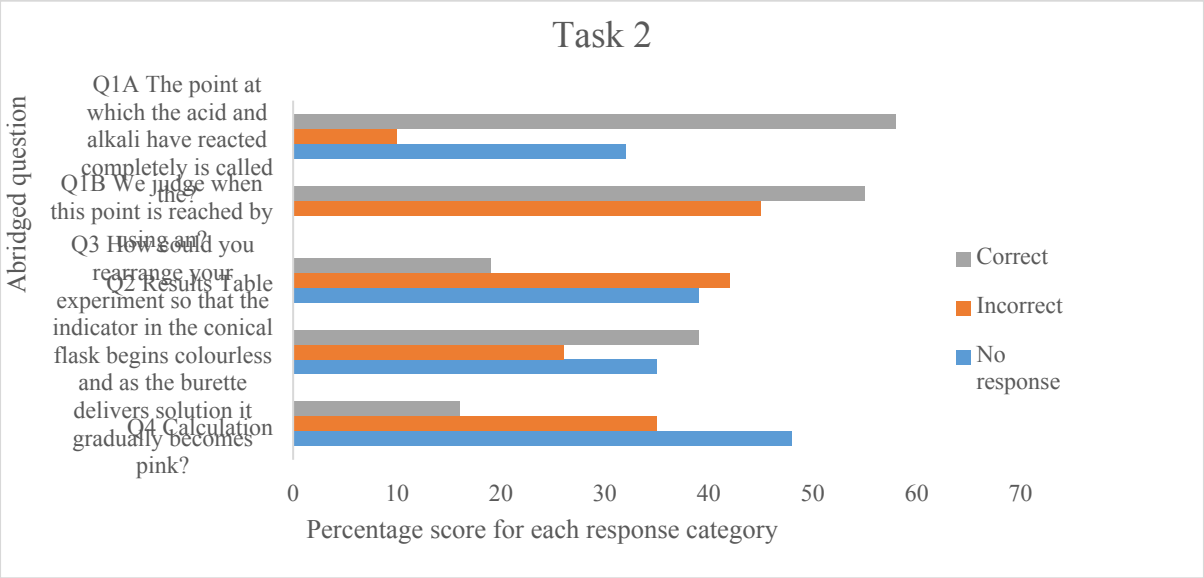
	Protocol Step	☑	Your Comments / Feedback Lab Partner
1	**Collect the necessary glassware and ensure it is clean** *To check: washing of glassware with water and small amounts of solution. Drying off any drops.*		
2	**Pipette 25 cm^3 sodium hydroxide of unknown concentration** *To check: filler is depressed 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.*		
3	**Adding 0.100 mol/dm^3 hydrochloric acid, to the burette** *To check: holding funnel above burette, do not add to zero mark, removing funnel.*		
4	**Stating initial volume of liquid (both of you check the reading)** *State reading to two decimal places the second should be either 0 or 5.*		
5	**Adding indicator and beginning titration** *To check: adding 2 - 3 drops **only** phenolphthalein presence of white tile, adding titrant while shaking flask, noting rate of colour change.*		
6	**Adding liquid dropwise towards end point** *To check: adding dropwise, washing burette tip and sides of flask with small amounts of water, successfully reaching end-point.*		
7	**State final volume of burette (both of you check the reading)** *State reading to two decimal places the second should be either 0 or 5.*		

Choose the value between 1 and 5 which most closely reflects your response to each of the statements below.

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
I watched the video before the lesson					
The quiz made me think more about the technique					
I felt more prepared before beginning the task than when there are no exemplar videos and pre-laboratory tasks					
I narrated my procedure, I tried to explain and justify the steps as I did them.					
I feel I have a better understanding of this technique because of the novel process.					
I found this a useful way to develop my laboratory skills.					
I found this a useful way to develop my understanding of this technique and its purpose.					
Understanding the practical work has helped me understand the calculation and theory more.					

Please use the space below to make any additional points that you feel should be considered before using this process in the future:

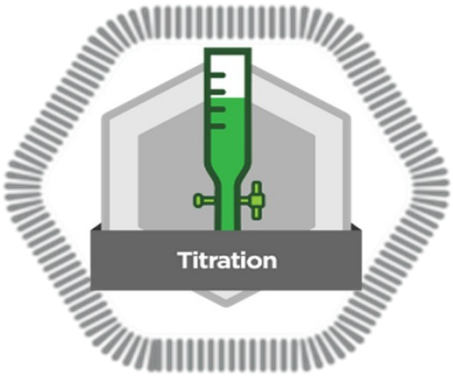
Appendix 4: Summary of the student responses to Task 2 activities completed whilst carrying out the practical task.



Appendix 5: Digital Badge and Award Criteria

GCSE Neutralisation Digital Badge

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



- carry out a titration between hydrochloric acid and sodium hydroxide
- accurately read the volume on a burette to 2 decimal places the second being either a 0 or 5
- calculate a titre
- identify concordant results.
- calculate an average titre from concordant
- describe how an indicator can be used to determine the end point
- explain how accuracy can be improved in a titration
- recall the main steps involved in the practical procedure.
- calculate the concentration of the sodium hydroxide