

1. Strong acids are not used in the medicine.

Methanoic acid and ethanoic acid are weak acids.

(i) What is the formula for a hydrogen ion?

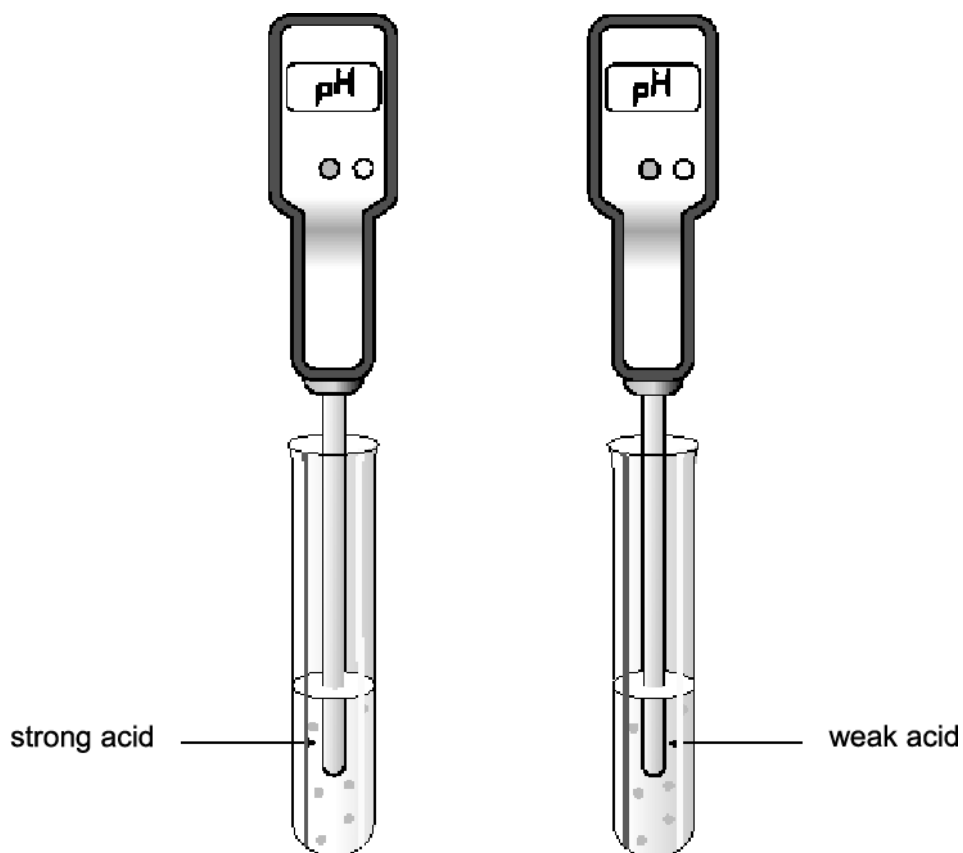
Put a **ring** around the correct answer.



[1]

(ii) Strong acids are more acidic than weak acids.

One way of telling the difference between a strong and a weak acid is testing the pH.



What results would you expect the pH meter to give for each acid?

[2]

2(a). A scientist works in a quality control laboratory for a chemical company.

The company makes acids for use in cleaning products.

The scientist tests two acids, acid A and acid B.

He does a series of titrations for each acid.

He does a rough titration. He then repeats the titration three times taking more care.

These are his results.

Acid	Volume of sodium hydroxide solution used in cm ³			
	Rough	Repeat 1	Repeat 2	Repeat 3
A	25.0	24.5	24.4	24.6
B	28.0	27.7	26.1	25.0

(i) What is the range of volumes of sodium hydroxide used for the repeats for each acid?

range for acid A: from _____ to _____ cm³

range for acid B: from _____ to _____ cm³

[2]

(ii) The scientist looks at the ranges to decide whether he needs to do more repeats.

Do you think he needs to do more repeats for acid A?

Do you think he needs to do more repeats for acid B?

Explain your reasons.

acid A _____

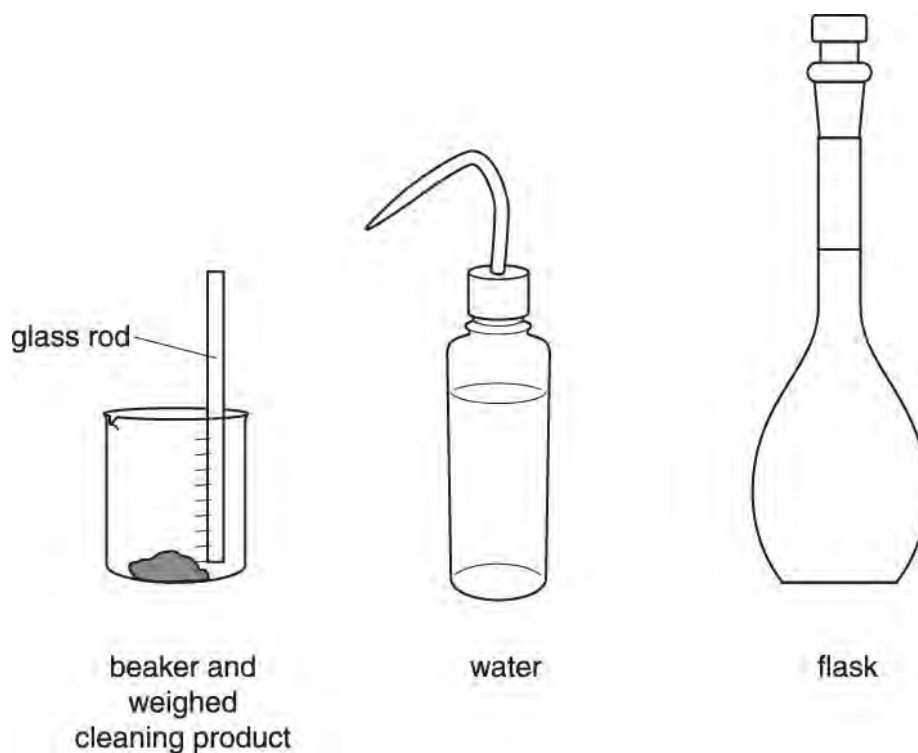
acid B _____

(b). The scientist tests the quality of one of the cleaning products.

He makes up a standard solution of a cleaning product.

He starts by weighing some of the solid cleaning product into a beaker.

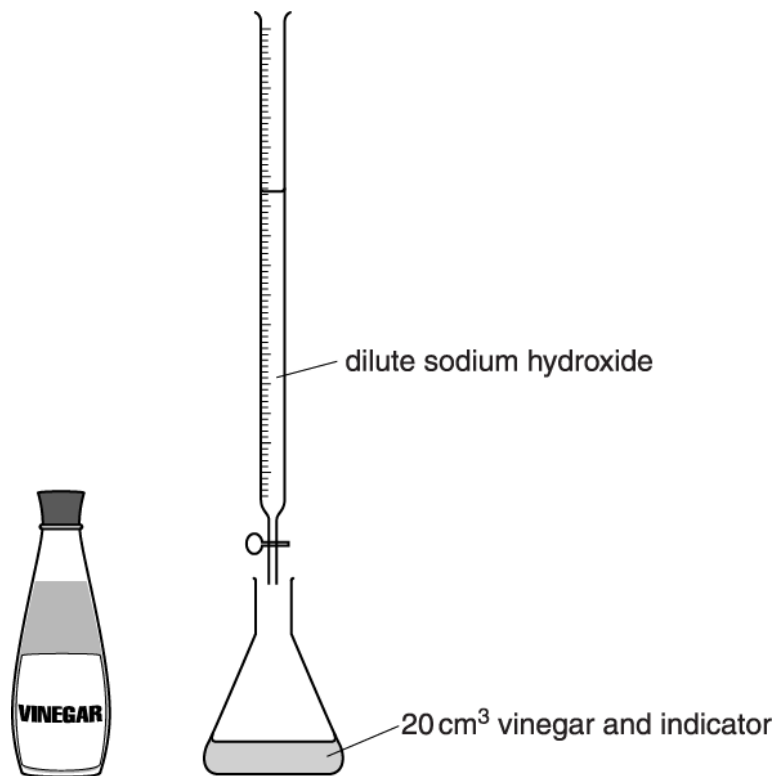
He uses this apparatus to make up his standard solution.



Write down how he should use this apparatus to make a standard solution of cleaning product.

4. Some students do titrations to find out the concentration of acid in vinegar.

The diagram shows the equipment they use.



Each student does a first titration then repeats the titration several times.

Each student calculates an average result from their repeats.

The first titration result is not used to calculate the average.

Which statement best explains why?

Put a tick (✓) in the box next to the best answer.

The first result is usually lower than the others.

The first titration is done without an indicator.

The students do not follow the method carefully the first time.

The first result is used to give a rough idea of the volume needed.



[1]

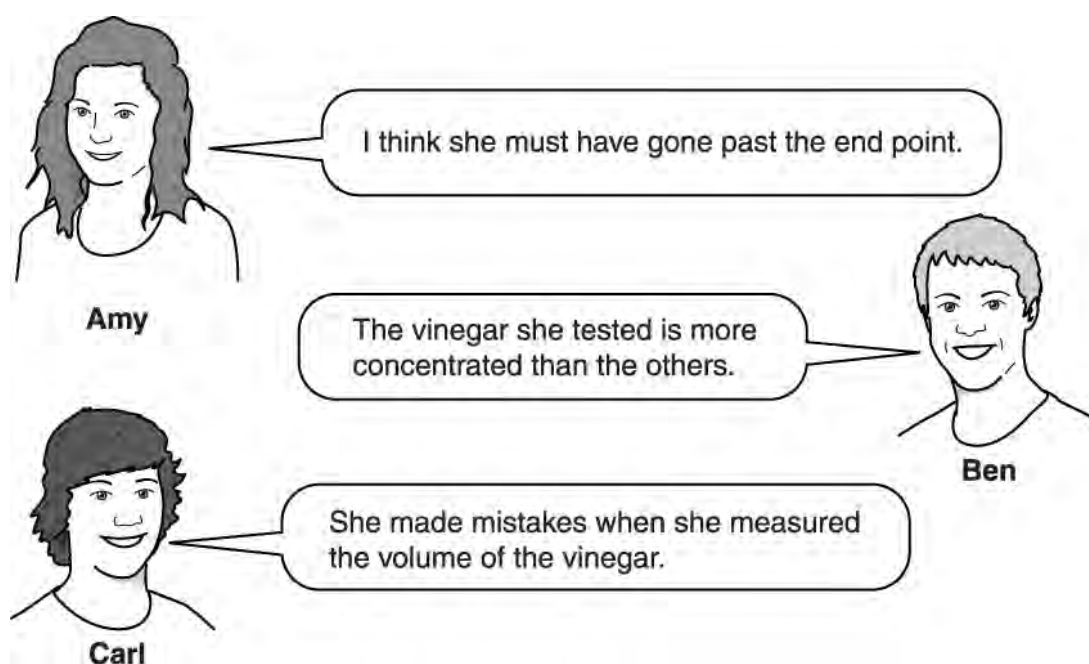
5(a). All students test vinegar from the same bottle and use the same concentration of sodium hydroxide.

The students record their average results in a table.

Name of student	Average volume of sodium hydroxide used in cm ³
Amy	23.4
Ben	24.1
Carl	23.8
Dee	18.2

The students notice that Dee's result is very different from the others.

They suggest explanations for this.



Which student has the best explanation for Dee's result?

Explain why you **agree** or **disagree** with the ideas suggested by each student.

Best explanation

Reasoning

.....
.....

----- [3]

(b). What is the word for the type of reaction that happens during this titration?

Put a ring around the correct answer.

crystallisation

evaporation

filtration

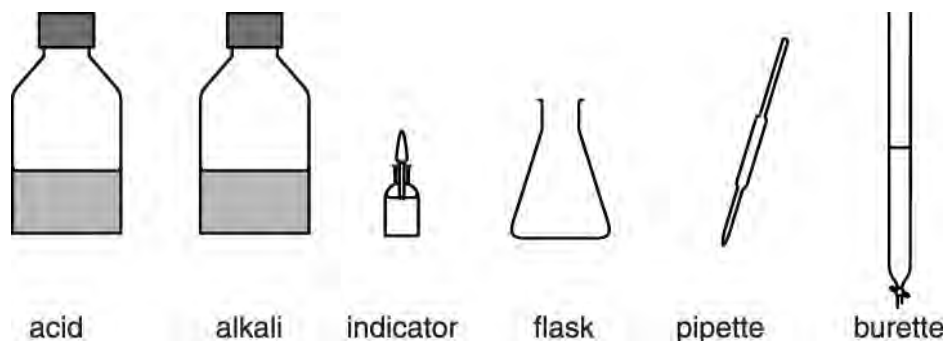
neutralisation

[1]

6(a). James does a titration with an acid and an alkali.

He uses dilute sulfuric acid, sodium hydroxide solution and an indicator solution.

He has a burette and a 25.0 cm³ pipette.



Describe how he would do a set of titrations to find out how much acid reacts with 25.0 cm³ of the sodium hydroxide.



The quality of written communication will be assessed in your answer.

[6]

(b). James gets these results.

titration number	1	2	3	4
volume of acid in cm ³	26.4	25.2	25.6	25.4

James decides that the best value for the volume of acid is 25.4 cm³.

Show how he arrived at this value.

----- [2]

(c). A factory makes a food additive which can be analysed by titration.

They take several samples throughout the day.

They analyse each sample as soon as it has been taken.

Suggest why they do these steps.

----- [3]

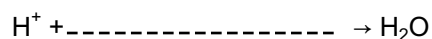
7(a). Milk of magnesia cures indigestion.

It neutralises acid in the stomach.

Milk of magnesia is a mixture of magnesium hydroxide and water.

The formula of magnesium hydroxide is $\text{Mg}(\text{OH})_2$.

Complete the equation for neutralisation.



[1]

(b). Kai buys two bottles of milk of magnesia, called **Gutcalm** and **Milkomag**.

He has a solution of hydrochloric acid.

He finds out how much acid is needed to neutralise 25 cm^3 from each bottle.

Here are Kai's results.

	Medicine	
	Gutcalm	Milkomag
Cost of a 250 cm^3 bottle	£1.75	£1.50
Volume of acid needed to neutralise 25.0 cm^3	24.0 cm^3	21.0 cm^3

(i) Which medicine gives the best value for money for neutralising acid?

[2]

(ii) Kai measures the 25 cm^3 of milk of magnesia using a beaker.

What could he do to measure the volume **more** accurately?

Tick (✓) **one** box.

Use a volumetric pipette.

Use a conical flask.

Use a large measuring cylinder.

Use a gas syringe.

[1]

8.

Ben says that spectroscopy is a qualitative technique.

He says that he wants to try a quantitative technique to find out more about the salts.

Draw lines to connect each technique with its use.

Technique	Use
Qualitative technique	Used to make samples of chemicals.
Quantitative technique	Used to measure the amount of chemical in a sample.
	Used to investigate the reactivity of a sample.
	Used for separation of chemicals.
	Used to find out what chemicals are in a sample.

[2]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1		i	H+ ✓	1	
		ii	idea that strong acid has a lower pH than a weak acid / gives values for both with strong acid below weak acid ✓ both are below 7 / gives both pH values below 7 ✓	2	
			Total	3	
2	a	i	24.4-24.6; (1) 25.0-27.7; (1)	2	Accept: 24.6-24.4; Accept: 27.7-25.0; Accept 25 instead of 25.0 Examiner's Comments This question proved difficult for many candidates. Although almost all knew what a range involved, many included the rough values rather than only the accurate value. A common answer which was accepted as correct, was to reverse the range, giving the higher value first.
		ii	Acid A no more repeats AND acid B needs more repeats; (1) Acid B range is large / results are not concordant / not consistent / not repeatable/ results vary OR Acid A results are close together / AW ; (1)	2	Allow Acid A 'No' AND Acid B 'Yes' for 1 mark Accept "Acid B results not reliable" Ignore "Acid B results not accurate" Ignore "Acid B results contain outliers" Ignore "because of the range" Examiner's Comments Most correctly asserted that acid A did not need more repeats, but acid B did, and linked this to the size of the ranges.

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	b	<p>add water (to the cleaning product and stir (with the glass rod);</p> <p>idea of dissolve/make a solution in the beaker;</p> <p>transfer to (volumetric) flask;</p> <p>make sure all solid is transferred/ rinse beaker into flask;</p> <p>fill up to line;</p> <p>shake thoroughly to mix:</p>	any 4	<p>Ignore 'make a solution' alone (repeats question)</p> <p>Examiner's Comments</p> <p>Most knew that the solution would be made in the beaker and transferred to the flask. However, many were not clear about the function of the flask. Some thought that it was used to measure out the volume of water, which would then be poured into the beaker. Others thought a mixture of solid and water would be placed in the flask before shaking. Only the most able discussed rinsing the beaker and rod into the flask or filling the flask exactly to the line.</p>
		Total	8	
3		<p>batch A is OK because each tablet is within the allowed range (1)</p> <p>batch B is unsatisfactory because the tablets contain less (than the minimum permitted amount) (1)</p> <p>batch C is unsatisfactory because the tablets contain more (than the maximum permitted amount) (1)</p> <p>batch D is unsatisfactory because some tablets contain more (than the maximum permitted amount) (1)</p>	4	<p>each answer must indicate whether the batch is satisfactory or unsatisfactory and explain why</p> <p>do not credit calculation and use of average / mean values</p> <p>Examiner's Comments</p> <p>The idea that all tablets within a batch must meet the standard of 1.0 g +/- 0.1 was not well understood by candidates with many basing their argument on the average of the results rather than the masses in the individual tablets within the batch. Some candidates discussed the values for each batch without saying whether or not it met the standard and others were not specific enough e.g. not saying whether results were too high or too low. A few thought that batches C and D met the standard because being too high did not matter.</p>
		Total	4	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
4			The first result is usually lower than the others.		1 Examiner's Comments Most candidates were able to select the correct reason for the preliminary titration.
			The first titration is done without an indicator.		
			The students do not follow the method carefully the first time.		
			The first result is used to give a rough idea of the volume needed.	✓	
Total				1	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
5	a	<p>Any 3 from: (Dee's result) is too low / lower than the others;</p> <p>Amy (going past the end point would make) volume of sodium hydroxide higher / volume would be 'too high';</p> <p>Ben (If the vinegar was more concentrated) more sodium hydroxide would be needed / volume would be 'too high' / all from the same bottle / same concentration;</p> <p>Carl Must have measured out <u>too little</u> vinegar at the start / AW;</p>	3	<p>no marks for 'Carl' alone all marks are for explanations Maximum 2 marks can be scored if Carl is not given as answer</p> <p>ignore 'Dee's result is very different / it is an outlier'</p> <p>ignore 'made mistakes when she measured the volume'</p> <p>Examiner's Comments</p> <p>In this question a mark was most often given for discounting Ben ie same bottle/same concentration. When they chose Carl often a general answer was given indicating measuring out too much or too little would affect the result, rather than specifically saying that Dee must have measured out too little. A significant number of candidates were confused as to what the phrase 'going past the end point' meant.</p>
	b	Neutralisation	1	<p>Examiner's Comments</p> <p>Most candidates were able to correctly select neutralisation, but when an incorrect response was selected it was most often filtration or crystallisation.</p>
		Total	4	

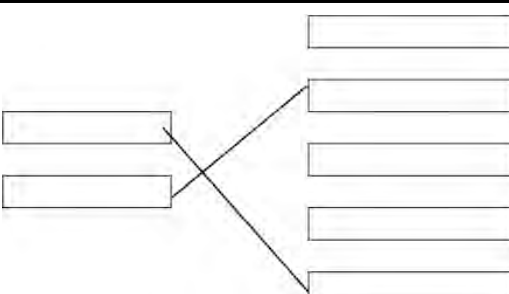
Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
6	a	<p>[Level 3] Describes the correct technique for a single titration, including collection of results. Discusses the need for several titrations. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>[Level 2] Describes a single titration and includes some discussion of measurement OR describes the correct techniques for titration and explains the need for repetition, omitting measurements. (may have described the alkali as being inside the burette) Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>[Level 1] Discusses the addition of acid to alkali in the presence of an indicator in a qualitative fashion only. Quality of written communication impedes communication of the science at this level. (1 – 2 marks)</p> <p>[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>This question is targeted at grades up to E Indicative scientific points may include:</p> <ul style="list-style-type: none"> • Suitable use of terms such as burette, pipette, pipette filler, [conical] flask or other suitable receptacle. • Acid into burette • Read burette at start and end • Subtract the readings to find the titre • Sodium hydroxide measured using pipette • Use of pipette filler • Into a [conical] flask • Few drops of indicator used appropriately • Reference to swirling the flask • Reference to colour change • Reference to neutralisation • Technique for a rough titration • Technique for an accurate titration • Need for several accurate titrations <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p> <p>Examiner's Comments</p> <p>Candidates were aware of neutralisation processes, and recognised this as a neutralisation reaction. However, many found it difficult to correctly sequence their ideas; indicator was frequently added at the end of the reaction and therefore the neutralisation would not work. In many instances, the alkali was described as being placed in a burette, rather than acid. The rubric clearly asked for consideration of a number of titrations, and few candidates discussed repetition of their experiments, or the reasons for repetition. Six marks could not be achieved without this as a factor in each candidate's response. Although a correct sequence may have been described, without explaining that it was necessary to observe the volume of acid added. The best responses, were those where it was evident that the candidate had experienced</p>

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
				the practical assignment themselves; clearly sequenced descriptions were explained; indicator was used (and a colour change made explicit); the volume of acid was noted, and finally, the experiment was described as having a “rough” titration initially, followed by several more attempts. In some cases, there was a description of the calculation of a mean.
	b	Any two from He calculated a mean; Ignored 26.4; It is an outlier / rough result;	2	Ignore it is in the middle of the other values Ignore take the median $25.2 + 25.6 + 25.4 [=76.2]$ divided by 3 (2) Examiner's Comments There were a number of very good responses here which included an explanation of James excluding an outlier, and how he calculated the mean. Incorrect responses were common; candidates described the value as the “median” value without considering the nature of the first result in the table.
	c	Any three from Might be checking for purity Checking the reliability of the process Idea of variation during the process [variation] with time Chance to take corrective action Check the sample quickly before it deteriorates / becomes contaminated Safety arguments	3	Examiner's Comments For full marks in this question, candidates needed to consider both parts to the question (the second was either ignored, or it wasn't clear from the response as to which part of the question was being discussed.) The best responses were those where candidates had explained the importance of checking for purity <i>over time</i> , and had then clearly explained that it was important that titration of collected samples should be immediate so that the sample didn't deteriorate. Many candidates appreciated that the samples may need checking due to safety and to protect consumers.
		Total	11	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
7	a	OH ⁻ ✓	1 (AO 1.1)	<p>Examiner's Comments</p> <p>This ionic equation proved to be highly problematic for most candidates, with many trying to include magnesium ions in their answer.</p>
	b	i	2 (AO 3.1a) (AO 3.2a)	<p>There must be some indication that a calculation has been performed</p> <p>IGNORE incorrect rounding as assessed elsewhere</p> <p>Examiner's Comments</p> <p>A minority of candidates realised that this question required a division calculation involving cost and price, and so gained at least some credit.</p>
		ii	1 (AO 2.2)	<p>Examiner's Comments</p> <p>The use of a volumetric pipette was well recognised.</p>
		Total	4	
8		<p>Qualitative Used to find out what chemicals are in a sample ✓</p> <p>Quantitative Used to measure the amount of chemical in a sample ✓</p>	2 (AO 2 × 1.2)	<div style="text-align: right;"> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> </div>  <p>Examiner's Comments</p> <p>Many of the higher ability candidates understood both of these terms.</p>
		Total	2	