



Christ Church  
Grammar School

# Year 12 Chemistry

## Volumetric analysis validation test 2021

Name: \_\_\_\_\_

Mark = ...../40

## Question 1

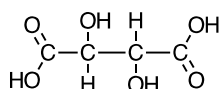
(30 marks)

Winemakers often use grape juice concentrates in their winemaking efforts. The concentrates are versatile as a basic material for the final product and also as a supplement to improve flavour. They are prepared by boiling grapejuice under pressure. The concentrates contain the same acids as those found in wine.

One such concentrate was found to have an average acid content of  $43.6 \text{ gL}^{-1}$ . To accurately determine the acid content of the concentrate, titration with sodium hydroxide solution was used.

The standardised sodium hydroxide had a concentration  $0.105 \text{ molL}^{-1}$ . The assumption was made that all the acid present was tartaric acid.

The structure of tartaric acid is shown below.



Tartaric acid is a diprotic weak acid. Refer to it as  $\text{H}_2\text{Ta}$  for the purposes of this question.

- (a) The concentrate requires dilution prior to titration. Using calculations, determine the appropriate dilution.

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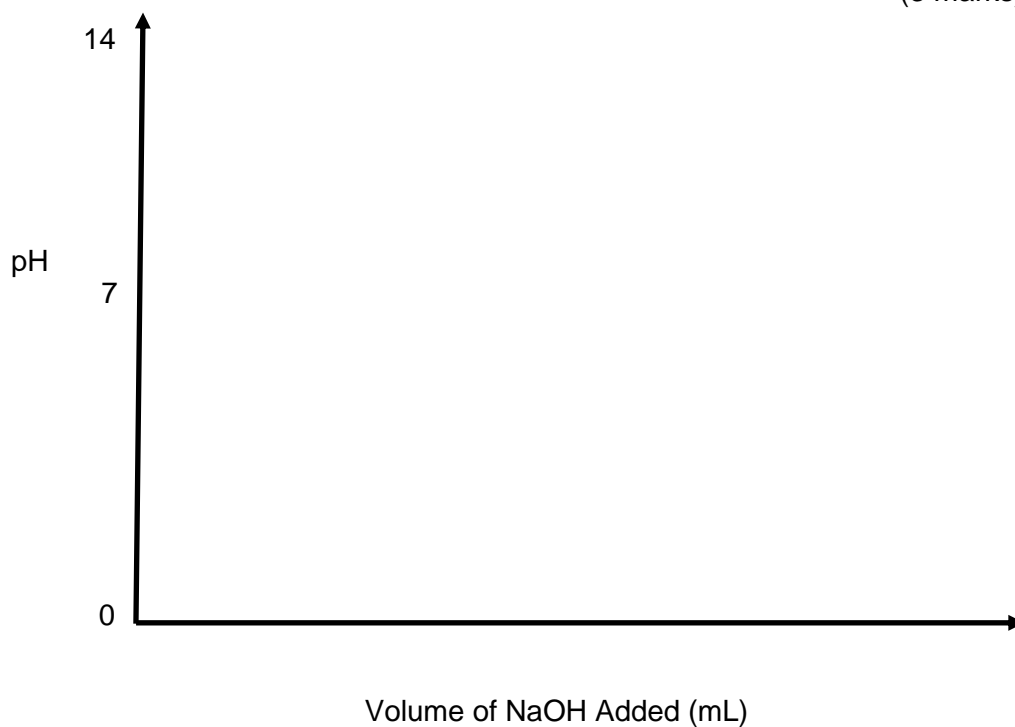
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(5 marks)



- (e) On the axis below, sketch a graph showing how the pH would be expected to change during the titration, until an excess of the sodium hydroxide was added.

(3 marks)



- (f) Below is a list of indicators that the students considered when designing their analysis.

indicator	pH range	Colour change
Bromothymol blue	6.2 – 7.6	Yellow → blue
Tropaeolin	0.2 – 1.5	Purple → Red
Thymol Blue	8.0 – 9.6	yellow → blue

Select the most appropriate indicator and explain your choice with the use of relevant equations.

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(4 marks)

- (g) Methyl orange indicator changes colour in the pH range 3 – 4.2. Explain the effect on the final calculated value for the tartaric acid concentration if methyl orange was used to identify the end point.

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(3 marks)

- (h) A group of students conducting the same experiment mistakenly rinsed their burette with the diluted wine before filling it with the standardised NaOH. Explain how this would affect their final calculated value of the tartaric acid concentration.

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(4 marks)

- (i) Give one random and one systematic error in this experiment.

Random

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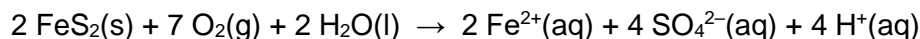
Systematic

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(2 marks)

**Question 2****(10 marks)**

When soils containing iron pyrite ( $\text{FeS}_2$ ) are exposed to air, the following reaction occurs.



These types of soils are called acid sulfate soils. The groundwater associated with these soils discharges into lakes and rivers.

- (a) What will happen to the pH of the groundwater.

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(1 mark)

A titration was carried out on a sample of lake water, suspected of being contaminated with acid soils, to determine its pH.

A student placed a standardised solution of  $5.00 \times 10^{-3} \text{ mol L}^{-1}$  NaOH in the burette. The student then titrated the NaOH solution against 50.0 mL samples of the lake water and obtained the following results.

	Trial 1	Trial 2	Trial 3	Trial 4
Final burette reading (mL)	3.80	8.05	12.00	16.05
Initial burette reading (mL)	0.00	4.10	8.10	12.05
Volume of NaOH used (mL)				

- (b) Determine the average volume of NaOH used. (2 marks)
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- (c) Assuming that the lake water is the only source of  $H^+$  ions and that complete ionisation of the acid in the lake water has occurred, determine the pH of the lake water.

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(4 marks)

- (d) Complete the following table

Equipment	Rinsed with	Correct / incorrect
Burette	Distilled water then $0.005 \text{ mol L}^{-1} \text{ NaOH}$	
Pipette	Distilled water	
Conical flask	Distilled water	

(3 marks)