

Further analysis and quantitative chemistry

1. Four labels have come off four bottles.

Ammonium sulphate solution $\text{Al}_2(\text{SO}_4)_3$ (aq)	Ammonium sulphate solution $(\text{NH}_4)_2\text{SO}_4$ (aq)	Magnesium sulphate solution MgSO_4 (aq)	Sodium sulphate solution $\text{Na}_2(\text{SO}_4)$ (aq)
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Describe and give the results of the **chemical** tests that you would do to identify which bottle contained which substance.

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(Total 5 marks)

2. In 1916, during the First World War, a German U-boat sank a Swedish ship which was carrying a cargo of champagne. The wreck was discovered in 1997 and the champagne was brought to the surface and analysed.

(a) 25.0 cm^3 of the champagne were placed in a conical flask.

Describe how the volume of sodium hydroxide solution needed to react completely with the weak acids in 25.0 cm^3 of this champagne can be found by titration, using phenolphthalein indicator.

Name any other apparatus used.

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(4)

- (b) The acid in 25.0 cm³ of the champagne reacted completely with 13.5 cm³ of sodium hydroxide of concentration 0.10 moles per cubic decimetre.

Calculate the concentration in moles per cubic decimetre of acid in the champagne.

Assume that 1 mole of sodium hydroxide reacts completely with 1 mole of acid.

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Concentration = moles per cubic decimetre

(2)

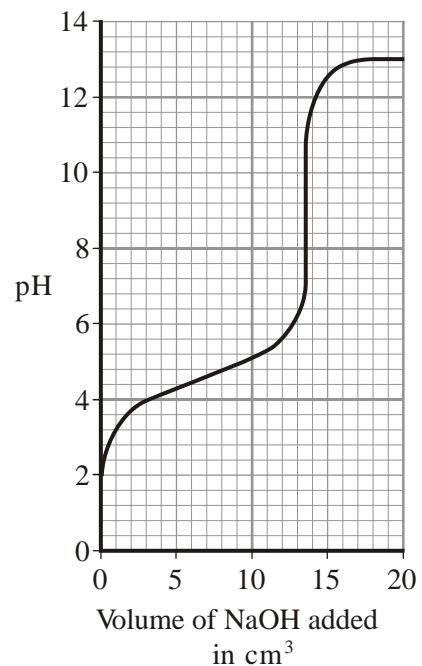
- (c) Is analysis by titration enough to decide whether this champagne is safe to drink? Explain your answer.

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(1)

- (d) The graph shows how the pH of the solution changes during this titration.
- Phenolphthalein is the indicator used in this titration. It changes colour between pH 8.2 and pH 10.0.
- Methyl orange is another indicator. It changes colour between pH 3.2 and pH 4.4.
- Suggest why methyl orange is **not** a suitable indicator for this titration.



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(2)

(Total 9 marks)

3. (a) This label has been taken from a bottle of vinegar.
- Vinegar is used for seasoning foods. It is a solution of ethanoic acid in water.
- In an experiment, it was found that the ethanoic acid present in a 15.000 cm³ sample of vinegar was neutralised by 45.000cm³ of sodium hydroxide solution, of concentration 0.20 moles per cubic decimetre (moles per litre).



The equation which represents this reaction is



Calculate the concentration of the ethanoic acid in this vinegar:

- (i) in moles per cubic decimetre (moles per litre);

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Concentration = moles per cubic decimetre

(2)

- (ii) in grams per cubic decimetre (grams per litre).
Relative atomic masses: H = 1; C = 12; O = 16.

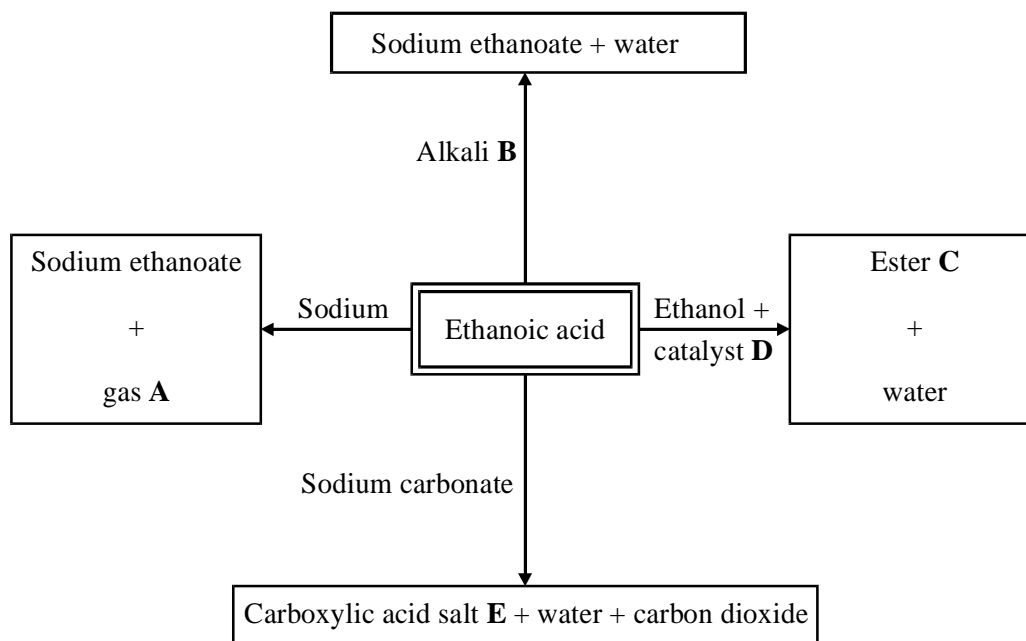
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Concentration = grams per cubic decimetre

(2)

(b) The flow diagram shows some reactions of ethanoic acid.



Give the name of:

- (i) gas **A**, (1)
 - (ii) alkali **B**, (1)
 - (iii) ester **C**, (1)
 - (iv) catalyst **D**, (1)
 - (v) carboxylic acid salt **E**, (1)
- (Total 9 marks)**