

Further analysis and quantitative chemistry

1. Four labels have come off four bottles.

Aluminium sulphate
solution
 $Al_2(SO_4)_3(aq)$

Ammonium sulphate
solution
 $(NH_4)_2SO_4(aq)$

Magnesium sulphate
solution
 $MgSO_4(aq)$

Sodium sulphate
solution
 $Na_2SO_4(aq)$

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 cm³ 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 cm³ 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)

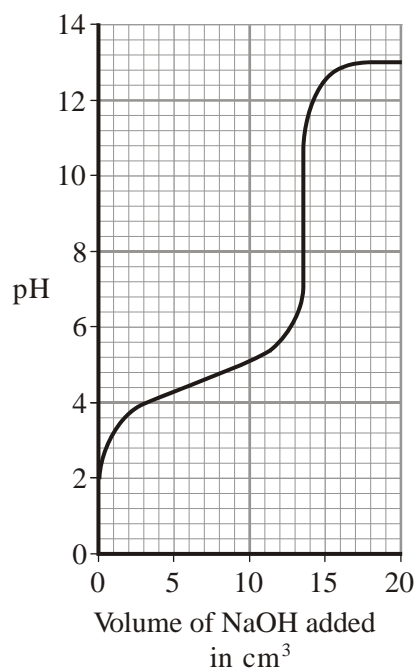
(c) Is analysis by titration enough to decide whether this champagne is safe to drink?

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)

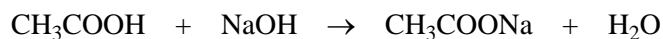
3. (a) This label has been taken from a bottle of vinegar.



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).

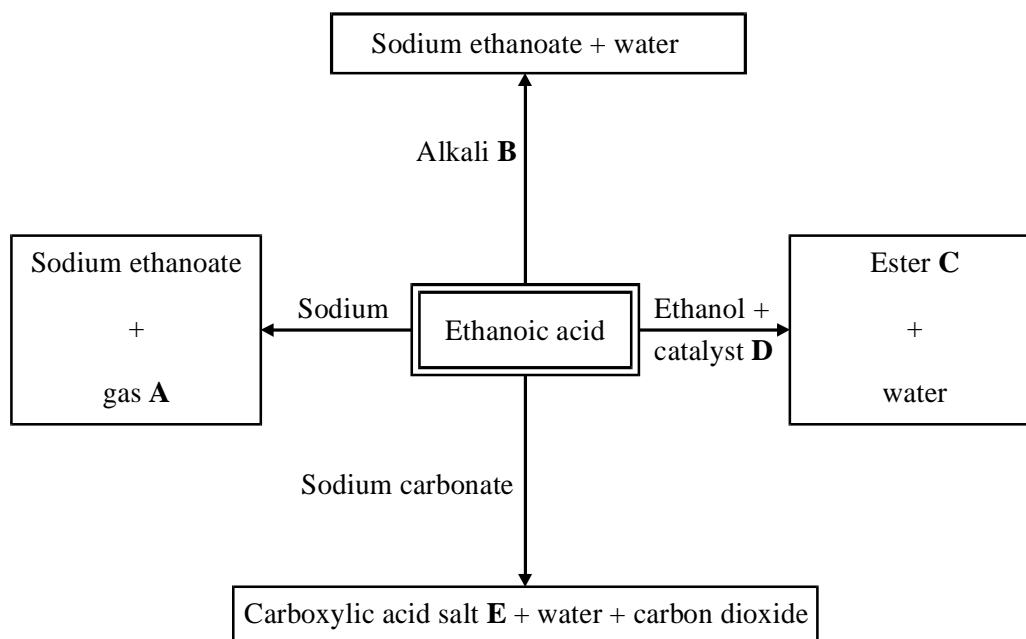
Relative atomic masses: H = 1; C = 12; O = 16.

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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**,

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(1)

(ii) alkali **B**,

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(1)

(iii) ester **C**,

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(1)

(iv) catalyst **D**,

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(1)

(v) carboxylic acid salt **E**.

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(1)

(Total 9 marks)