Year 12 Chemistry Test **NAME**_____

Topic 2: Analytical Techniques

Total marks: 37

1. Credit will be given for the correct use of significant figures in part (a).

   (a) The following procedure is used to determine the concentration of hydrogen peroxide:

   Step 1 Dilute 25.00 mL of the commercial hydrogen peroxide solution to 250.0 mL with water.

   Step 2 Pipette 20.00 mL of this dilute hydrogen peroxide solution into a conical flask and acidify.

   Step 3 Titrate with potassium permanganate solution that has a concentration of 0.02123 mol L^{-1}. The equation for the reaction is shown below:

   $$5H_2O_2 + 2MnO_4^- + 6H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$$

   In one titration, a titre of 27.63 mL was required to completely react with the dilute hydrogen peroxide solution.

   (i) Calculate the number of moles of MnO_4^- that reacted in the titration.

   (3)

   (ii) Calculate the number of moles of hydrogen peroxide in the 20.00 mL of dilute solution.

   (3)

   (iii) Calculate the concentration, in mol L^{-1}, of hydrogen peroxide in the commercial hydrogen peroxide solution.

   (4)

(iv) Calculate the concentration, in %w/v, of the commercial hydrogen peroxide solution.

(3)

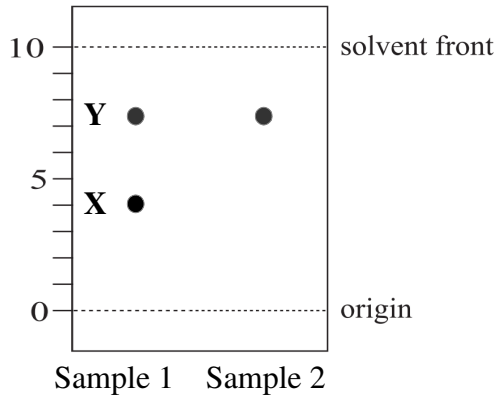
(b) State whether the conical flask should be rinsed with distilled water or with the dilute hydrogen peroxide solution immediately before titration.

_____ (1)

(c) State whether the titre value would be greater if the burette was rinsed with distilled water or permanganate solution immediately before the titration.

_____ (1)

2. Samples from some experiment were analysed by thin layer chromatography, using a polar stationary phase and a non-polar mobile phase. The chromatogram obtained is shown in the diagram below:



(a) Calculate the R_f value of component **X**.

(2)

(b) Identify which, of component **X** and component **Y**, is the more polar compound and explain your answer.

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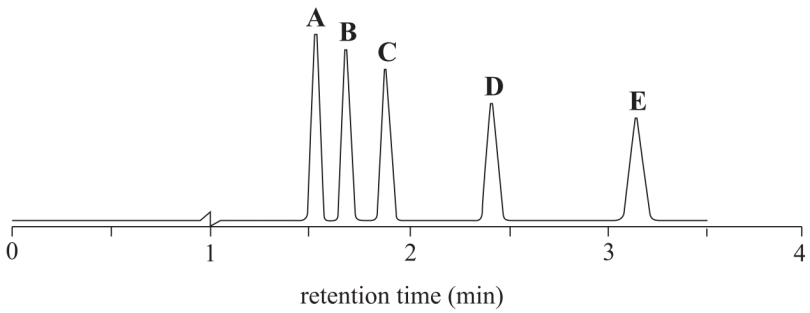
_____ (3)

3. Gas chromatography can be used to check the identity of the components of perfume.

(a) The retention times of some of the components of a perfume can be determined from the following chromatogram:

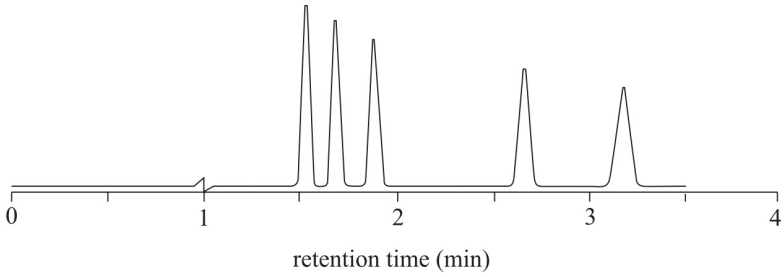


Chromatogram 1

Determine the retention time, in minutes, of component **D**.

_____ (1)

(b) The chromatogram of an imitation perfume, obtained under the same conditions as for the original perfume in Chromatogram 1, is shown below:



Chromatogram 2

State and explain how these two chromatograms indicate the difference between the imitation perfume and the original perfume.

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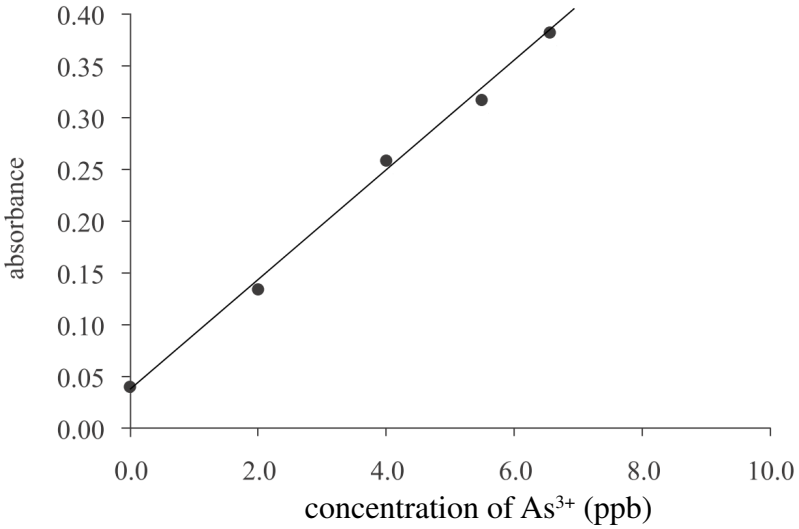
_____ (3)

4. The soil in a particular area was suspected to be contaminated with arsenic.

Absorption spectroscopy was used to test the level of arsenic in a sample of the soil.

The following calibration graph was prepared using standard solutions of As^{3+}.



(a) The sample of soil, of mass 0.45 g, was dissolved in acid, filtered, and then made up to 10.0 mL. The absorbance of the resultant solution was measured and the concentration of As^{3+} was found to be 3.5 ppb.

(i) Using the calibration graph, determine the measured absorbance of the solution.

_____ (1)

(ii) Calculate the mass, in μg, of arsenic in the 10.0 mL of solution.

(2)

(iii) Hence determine the concentration, in ppb, of arsenic in the sample of soil.

(2)

(b) The solution also contained sulfuric acid from the dissolving step.

Explain why the presence of sulfuric acid in the solution during the absorption spectroscopy would not have affected the results of the analysis.

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_____ (2)

(c) Identify one feature of the calibration graph that indicates the presence of a systematic error.

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_____ (1)

5. An investigation is conducted to determine the concentration of Sn^{2+} ions in some tinned liquid. The Sn^{2+} is expected to be at a concentration of about 0.01 mol L^{-1}, and reacts in a 1:1 mole ratio with hydrogen peroxide. Assume the Sn^{2+} solution is visibly coloured and the product of its reaction with hydrogen peroxide is colourless.

Write a procedure to determine the concentration of Sn^{2+} ions, given 100 mL of the tinned liquid and:

- tin (II) nitrate (powder)
- 1.00 mol L^{-1} hydrogen peroxide
- any other required equipment or chemicals

You are *not* required to use both tin (II) nitrate and hydrogen peroxide.

(5)

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