# Topic 2: Analytical Techniques

*Chemists perform a wide variety of monitoring roles, including analysing for drug residues and measuring the concentrations of pollutants such as pesticides in the environment. Chemists are also employed to analyse materials used in or produced by many branches of industry, including pharmaceuticals, polymers, metal production, and food preparation. In this topic students consider some of the more common means of analysis and undertake practical activities in measurement.*

## WEEK 9-10

### 2.2 Chromatography

- Adsorption chromatography involves the use of a stationary phase and a mobile phase to separate the components of a mixture.
- The strength of attraction between two substances depends on their relative polarities.
- The rate of movement of any component along a stationary phase is determined by the structure or relative polarity of the component and the relative polarities of the stationary phase and the mobile phase.
- The rate of movement of a component along a stationary phase is compared with a known standard in order to identify the component.

### TOPIC CHECKLIST

- ☐ Identify the stationary and mobile phases in an adsorption chromatography process.
- ☐ Predict the relative strengths of attraction of components for the stationary phase and the mobile phase on the basis of their polarities.
- ☐ Predict the relative rates of movement of components along a stationary phase, given the structural formulae or relative polarities of the components and the two phases.
- ☐ Describe and apply $R_F$ values and retention times in the identification of components in a mixture.

## 2.3 Atomic Spectroscopy

- Electrons move to a higher or lower energy level when atoms or ions absorb or emit radiation.
- The wavelengths of radiation emitted and absorbed by an element are unique to that element.
- The wavelengths of radiation absorbed by an element can be used to identify its presence in a sample.
- Atomic absorption spectroscopy is used for quantitative analysis.

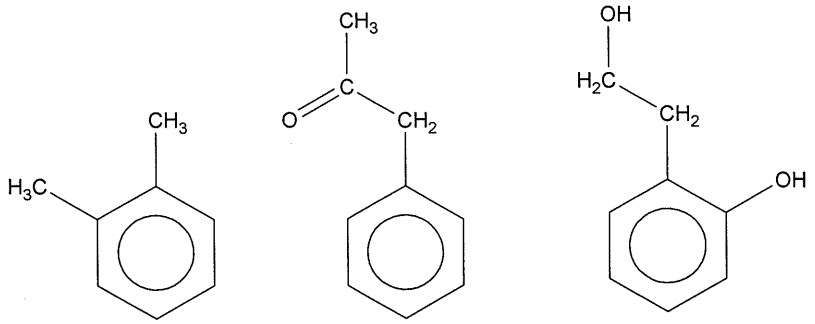
### TOPIC CHECKLIST

- ☐ State the effect of the absorption or emission of radiation on the energy levels of electrons in atoms or ions.
- ☐ State that the wavelengths of radiation emitted and absorbed by an element are unique to that element.
- ☐ Explain the principles of atomic absorption spectroscopy in identifying elements in a sample.
- ☐ Describe the construction and use of calibration graphs in determining the concentration of an element in a sample.

# Chromatography Assignment

## QUESTION 1

a) Thin layer chromatography is a common analytical technique. A sample was placed on a thin layer of aluminium oxide and hexane was used as a solvent to separate the components A, B and C in a sample.




A B C

i) Name the stationary phase in the experiment.

..... (1 mark)

ii) State, with reasons, which of the substances A, B and C would be most soluble in the hexane and which would be least soluble.

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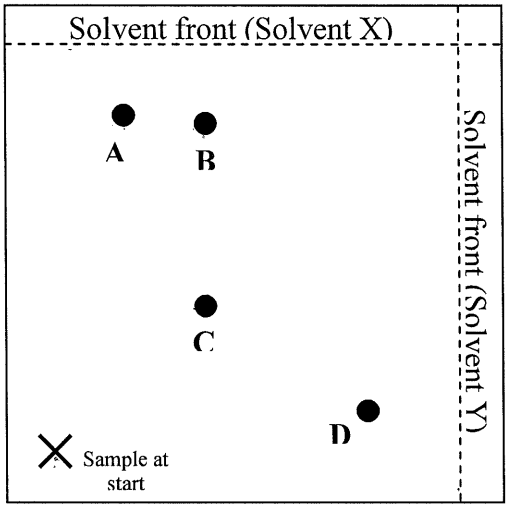
..... (4 marks)

iii) State which of the three substances A, B and C will be moved furthest from its original position in the experiment.

..... (1 mark)

b)




i) Identify:
the amino acid that is most soluble in solvent Y.

.....(1 mark)

the amino acid that has moved equal distances in the two solvents

..... (1 mark)

the amino acids most difficult to separate if *only* Solvent Y had been used.

..... (2 marks)

ii) Calculate the $R_f$ for D in each solvent.

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.....(2 marks)

iii) Draw the chromatogram as it would appear after only Solvent X had been used.

(4 marks)

# Atomic Spectroscopy Assignment

## QUESTION 1

a) To determine the iron content in a drink a 10.0 mL sample was diluted to 100.0 mL. The absorption of the diluted solution and several standard solutions were measured using AAS. The results are shown in the table.

| Solution concentration (ppm) | Absorption |
|---|---|
| 0 | 0.004 |
| 1.00 | 0.16 |
| 2.00 | 0.30 |
| 3.00 | 0.43 |
| 4.00 | 0.57 |
| Sample | 0.33 |

i) State what is meant by AAS.

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(1 mark)

ii) Plot the graph on graph paper showing absorption against concentration.

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(6 marks)

iii) From the graph determine the concentration of iron in ppm in the diluted drink.

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(1 mark)

iv) Determine the concentration of iron in ppm in the undiluted drink.

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(1 mark)

v) Calculate the mass of iron present in a cup (=250 mL or 250 g) of undiluted drink.

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(3 marks)

vi) The recommended daily dose of iron for people over 11 years of age is 18 mg. Calculate the number of cups of this drink a person would need to drink to obtain their daily requirements of iron solely from this.

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(2 marks)

**QUESTION 2**

*Credit will be given for answers to Question 3 which show clear well-expressed ideas and which present accurate and relevant information in a well-organized, logical manner. Your answer, which may include a diagram, should be confined to the space provided.*

Most multivitamin preparations also contain other metal ions such as $Ca^{2+}$, $Cu^{2+}$, $Mg^{2+}$ and $K^{+}$ as well as iron. Describe the process of AAS, explaining why the other metal cations do not interfere with the analysis for iron using AAS.

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(8 marks)