

BTEC NATIONAL (LEGACY) DIPLOMA IN APPLIED SCIENCE (FORENSIC SCIENCE)



UNIT: 19. Practical chemical analysis QCF: Level 3

ASSIGNMENT TITLE: Spectroscopic techniques of analysis

Date issued: 10/02/11	Date due: 24/02/11	Date of return:
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Context

You are a scientist working in a forensic laboratory. The laboratory is dealing with a case which involves an illegal 'home drugs factory'. The police have raided the premises and seized various chemical equipment and apparatus, together with a number of unidentified substances

You have been asked to identify these unknown substances using a variety of spectroscopic, and other, means. You must produce a report which will go to the prosecution which explains some of the scientific background to your analysis, together with your analysis of the unknowns and your conclusions.

OUTCOMES & ASSESSMENT CRITERIA

Understand the design and operating principles of selected spectroscopic instruments and be able to use spectroscopic methods to analyse chemical substances

Spectroscopic instruments: e.g. ultraviolet/visible spectroscopy, infrared spectroscopy, ^1H NMR spectroscopy, atomic spectroscopy, mass spectrometry; block diagrams showing key components; basic principles of operation e.g. energy sources, optics, magnets, detectors

Spectroscopic techniques: e.g. infrared spectroscopy, absorption bands and correlation charts, identification of organic functional groups, origin and uses of the fingerprint region; ultraviolet/visible spectroscopy, Beer-Lambert law, measurement of absorbance, construction of calibration curves, measurement of concentration, determination of molar absorption coefficients; atomic spectroscopy, applications of absorption and emission spectroscopy, criteria for method selection, use in quantitative analysis, calibration curves and internal standards; ^1H NMR spectroscopy, conditions for NMR activity, examples of other NMR active nuclei in addition to H, TMS as internal standard, correlation charts, integration traces, spin-spin splitting, identification of simple organic compounds from ^1H NMR spectra; mass spectrometry, measurement of relative molecular mass, simple fragmentation patterns

Pass	Merit	Distinction
P2 use and explain the principles of operation of selected spectroscopic techniques to accurately measure unknown concentrations	M2 interpret spectroscopic data from individual sources	D2 collate spectroscopic and other data from a variety of techniques to identify unknown compounds

TASK 1

The first part of the report (sections a and b) is to provide background information on the techniques used.

- a) Write a brief description and explanation of the principles of the following spectroscopic methods:

ultraviolet/visible spectroscopy
infrared spectroscopy
¹H NMR spectroscopy
mass spectrometry

To do this you could produce block diagrams and/or simple descriptions and statements.

P2

- b) By referring to the IR spectra labelled samples A-D, explain what information can be deduced from these spectra alone.

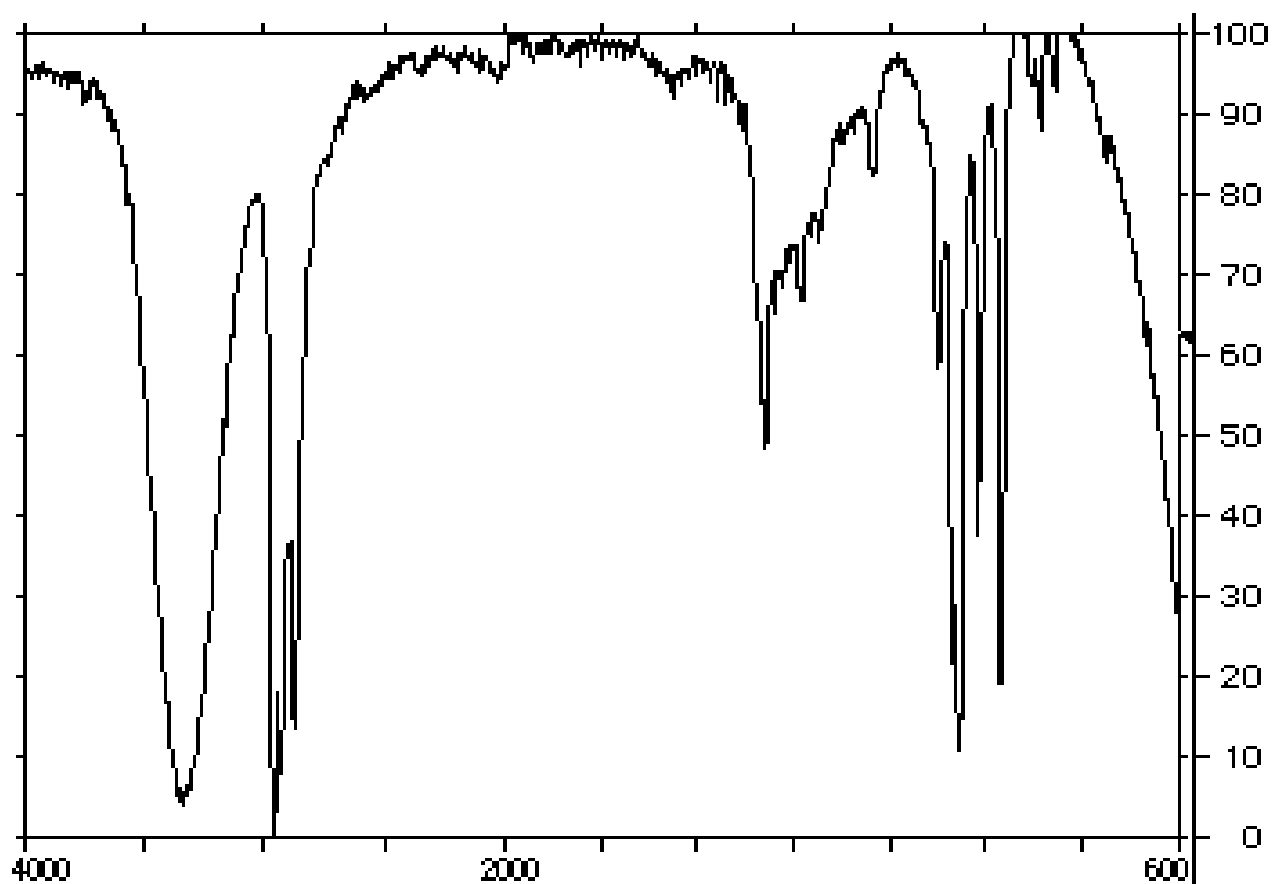
On one sample identify the finger print area.

For each of the samples identify if they are acid, ester, aldehyde, ketone, alcohol, alkene, aromatic, alkane or alkyl bromide.

(You are not expected to produce a complete identification of the samples for M2)

You have the IR spectra for an organic liquid (below) that was found on the clothes of a criminal defendant. The crime scene was heavily contaminated with a mixture of hydrocarbons, but there were no ketones, aldehydes, acids or alcohols present. Is the defendant's clothing contaminated with a hydrocarbon? Would this spectral evidence put the suspect at the crime scene? Justify your answer using IR functional group information.

M2



c) Using all the information provided, identify the unknown substances, labelled Samples 1-3. Your report should explain clearly how the information has been used to identify the unknowns, together with any additional information that you have used to complete your identification.