Solutions to Exercises – chapter 15

15.1) Compare and contrast the use of impactors and impingers.

Impinger devices collect both solid particles and aerosols. Dry impingers are also sometimes known as impactors and, as the name suggests, impingers involve air streams impinging on surfaces. The surface upon which the air stream impacts normally takes the form of a slide – e.g. glass. A number of impactors are arranged so that the air stream travels through a series of jets with diminishing diameters to selectively collect particles down to a few microns in diameter. In practice impingers of this type are normally used for the collection of aerosols and microscopic examination.

15.2) Why are personal monitors sometimes used in place of impinger or impactor based sampling devices?

Personal monitors are sometimes used in the place of impinger or impactor based devices, since personal monitors record the exposure of an individual person to potentially hazadards (irrespective of their movements) - as opposed to the environmental contamination found at a specific location.

15.3) What is meant by the Biological Oxygen Demand (BOD) within environmental monitoring and what is its significance?

All living organisms respire and so consume oxygen. It follows that all organisms impact a *biological oxygen demand (BOD)* to the environment and for this reason the BOD is a widely used criteria for assessing the environmental well being or otherwise of ecosystems. For some analyses it is necessary to *fix* gases via the use of reagents to prevent the gaseous content of samples being altered with time as a consequence of continued biological activity, and this is especially important if samples are to be transported some distance to a laboratory.

15.4) Describe a practical approach for determining NO_2 concentrations within air samples.

Nitrogen dioxide (NO_2) concentrations within the atmosphere can be determined following absorption of nitrogen dioxide into a solution of sulphanilic acid containing an azo dye. A pink colouration is formed upon reaction with hydrogen peroxide and allows concentrations of NO_2 as low as 5ppm to be determined.

Analyses for total oxides of nitrogen (excluding nitrous oxide) – (eg, from gaseous effluents from combustion processes) are performed by first collecting gas within an evacuated flask containing a hydrogen peroxide solution in dilute sulphuric acid. The oxides of nitrogen are converted into

nitric acid upon dissolution, and the nitrate ion is allowed to react with phenol disulphonic acid to produce a yellow product that can be determined colourometrically. This approach typically allows lower limits of detection down to concentrations of 5ppm in the atmosphere.

15.5) How may sulphur dioxide concentrations be determined?

Air-borne sulphur dioxide may be determined by first passing the air sample through a solution of sodium tetrachloromercurate. Sulphur dioxide is retained by the formation of dichlorosulphursitomercurate (II) ion $HgCl_2SO_3^{2-}$. This complex is then allowed to react with formaldehyde and pararosaniline to form a pararosaniline methylsulphonic acid which is highly coloured with a λ_{max} at 560nm. This permits spectrophotometric lower limits of around 0.003ppm SO_2 within the atmosphere. This form of analysis has been automated within a number of commercial instruments.

15.6) Describe a practical approach for determining the concentration of polychlorinated biphenyls (PCBs) within environmental samples.

Most determinations are performed using either gas chromatography or gas chromatography mass spectrometry GC-MS.

Sample preparations for either approach are essentially similar using, for example, either hexane or acetone. The solvent in either case must normally be dried using anhydrous sodium sulphate. Concentration steps may be

undertaken either via partial solvent evaporation or solid phase extraction and possibly further sample clean up for particularly problematic samples.

Final separation and / or identification may be achieved using either GC or GC-mass spectrometry. Identification of individual analytes, (especially when using GC-MS), can be performed by matching spectra with those obtained using known samples.