VARIOUS INSTRUMENTS USED IN FORENSIC DOCUMENT EXAMINATION

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BASIC TOOLS FOR FDE

- Excellent eyesight: Three dimensional binocular vision capable of differentiating minute variations between writing materials. Most sensitive instrument in visible spectral region that God has given us is "Vision" which is the most significant tool of a document examiner.

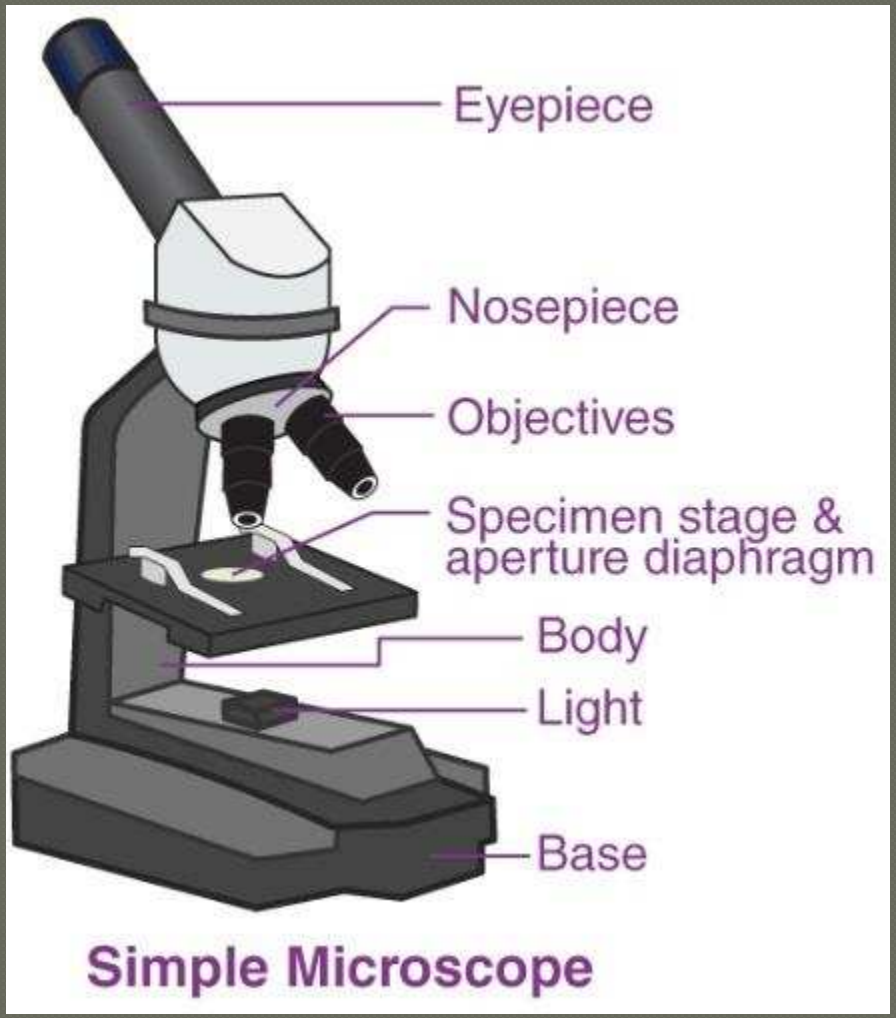
In addition to this tool, the outer tools which facilitate the examiner to see the small details which involve proportions or separations of less than 1/250th of an inch are not seen by the naked eye which is facilitated by other tools as following.

Basic Tools:

Basic tools comprises handheld magnifiers enlarge the objects from 2 to 10 times (magnification powers of 2X to 10X), metric rulers, callipers for fine measurements and an assortment of glass alignment plates which allow comparison and measurement of angles, height, width and spacing of handwriting and typewriting.

- Simple Microscope:
  It is defined as the type of microscope that uses a single lens for the magnification of the sample and has convex lens with a small focal length. The magnifying power of the simple microscope is given as m = 1 + D is the least distinct vision/F is the focal length of the convex lens.

  The working principle of a simple microscope is that when a sample is placed within the focus of the microscope, a virtual, erect and magnified image is obtained at the least distance of distinct vision from the eye that is held at the lens.

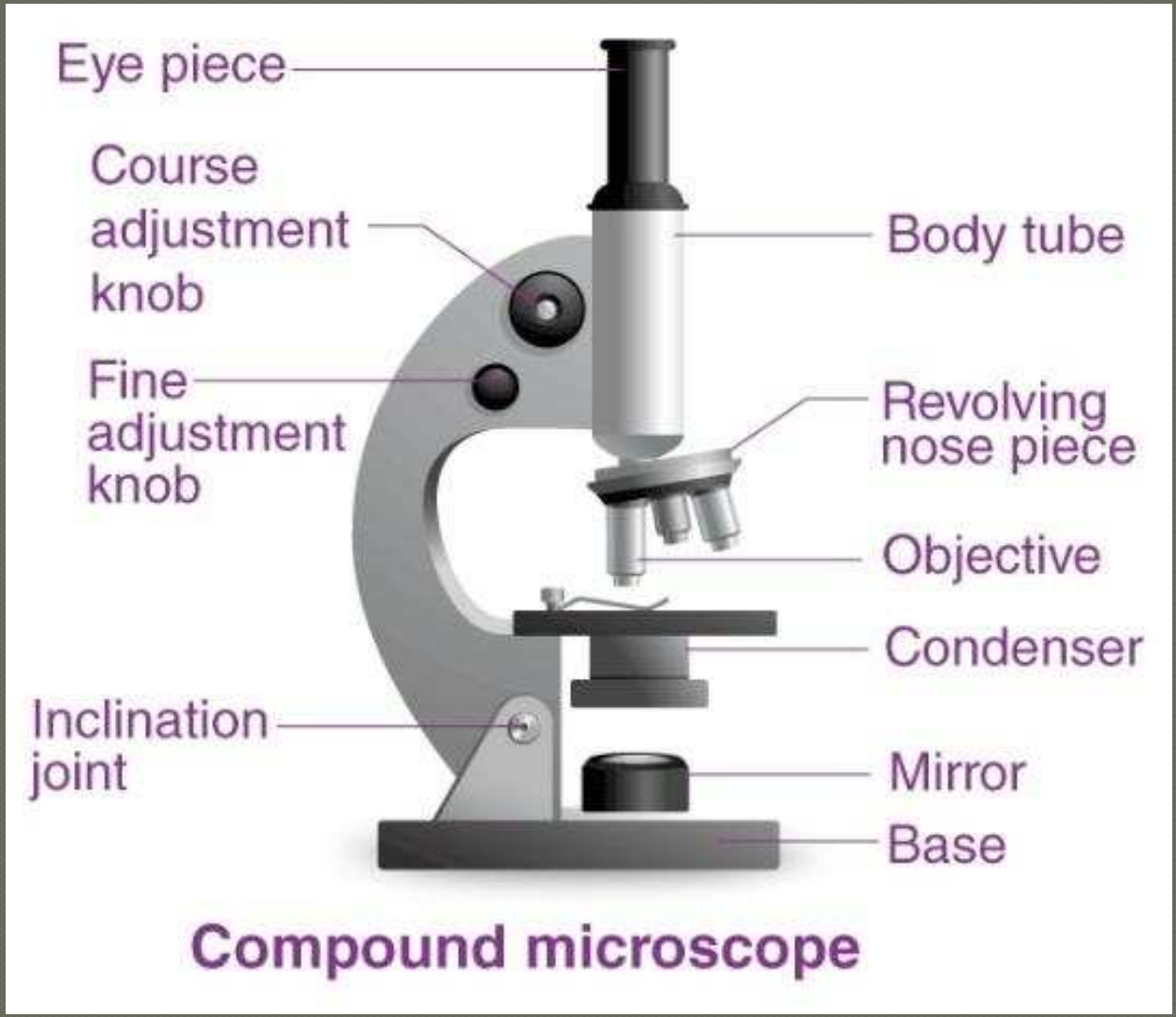


Simple Microscope

- Compound Microscope :

It is defined as the type of microscope that has more than one lens. It has a combination of lenses and two optical parts known as an objective lens and an eyepiece. The magnifying power of the compound microscope is given as m = D is the least distinct vision/f_o is the focal length of the objective lens x L is the length of the microscope tube/f_e is the focal length of the eyepiece.

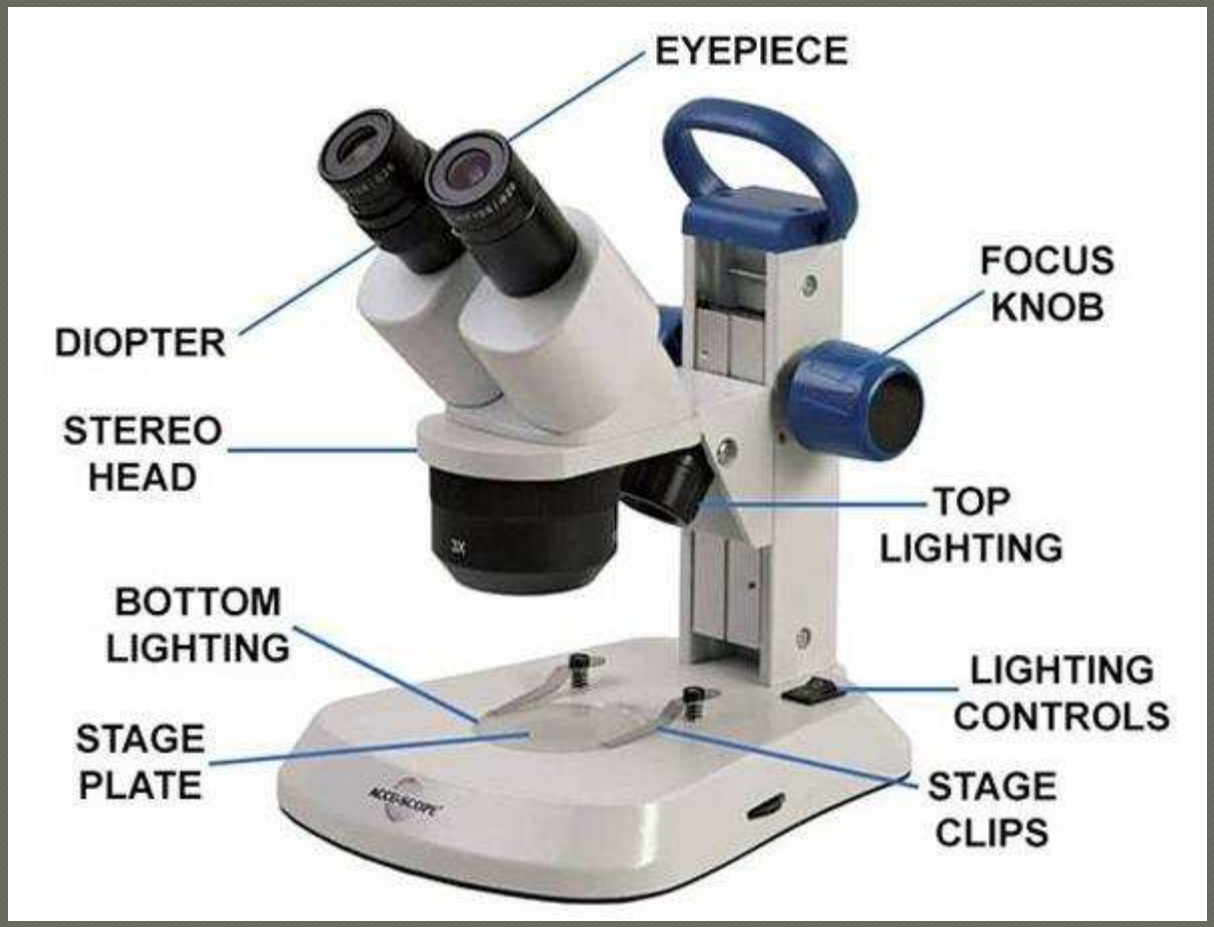
The working principle of the compound microscope is that the combination of lenses enhances the magnification of the sample. The sample is first viewed as a primary image in the tube and viewed again in the eyepiece.


Eye piece
Course adjustment knob
Fine adjustment knob
Body tube
Revolving nose piece
Objective
Condenser
Inclination joint
Mirror
Base
Compound microscope

- Stereomicroscope :

A stereo microscope is an optical microscope that provides a three-dimensional view of a specimen. It is also known by other names such as dissecting microscope and stereo zoom microscope. Dissecting microscope parts include separate objective lenses and eyepieces. As a result, you have two separate optical paths for each eye. The slightly different angling views to the left and right eyes produce a three-dimensional visual. Because it gives the three-dimensional view it is also called as the dissecting microscope.

The Characteristics of a Stereo Microscope:
Two separate objectives
Two separate optical paths
Uses the light reflected from the object
Typical magnification range between 10x and 50x
Three-dimensional image

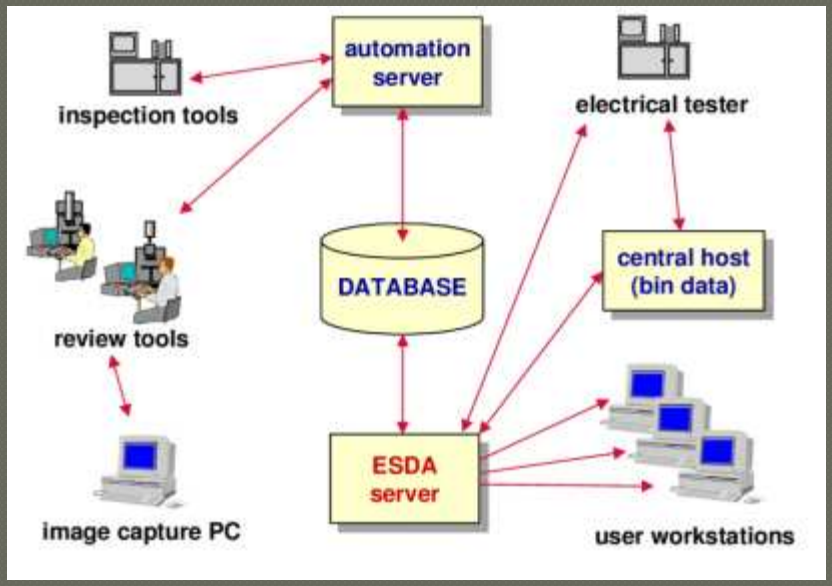


Stereomicroscope

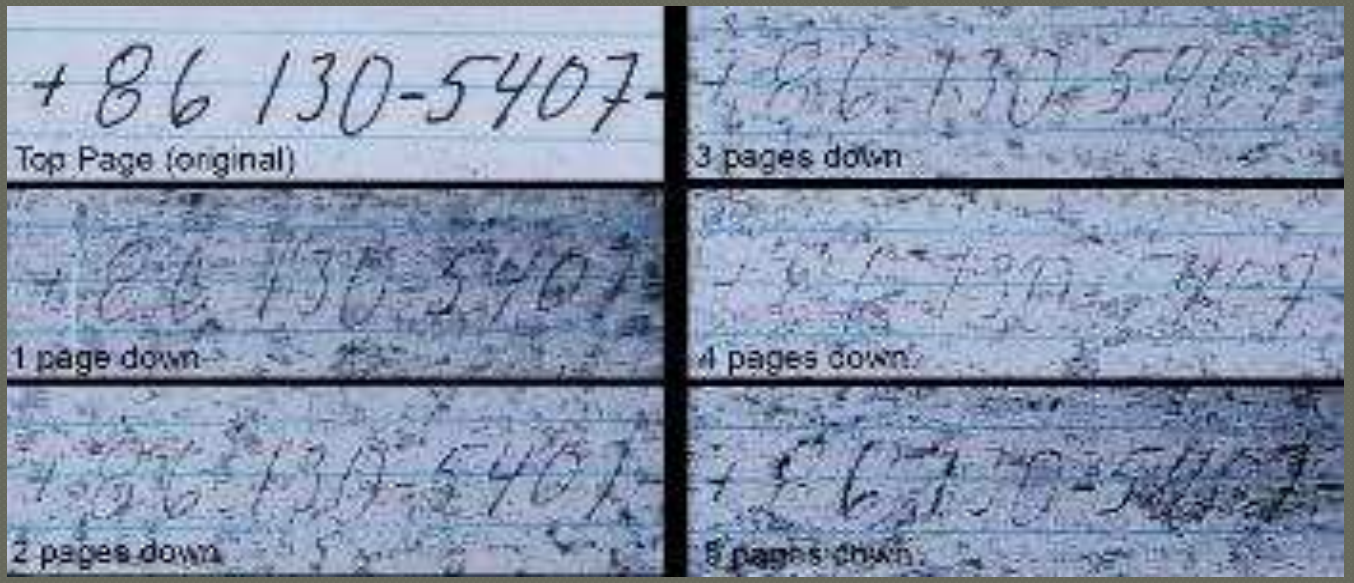
- Electrostatic Detection Apparatus (ESDA) :

It is a specialized piece of equipment commonly used in questioned document examination to reveal indentations or impressions in paper that may otherwise go unnoticed. It is a non-destructive technique (will not damage the evidence in question), allowing further tests to be carried out. It is a sensitive technique capable of detecting indentations on pages several layers below the top sheet and many years after the indentations were created through the electrostatic method of detection.

Impressions made on paper affect its dielectric properties, so an electric charge applied to the surface produces a potential different where impressions are present from that of the surrounding area. The effect is of considerable value to the document examiner and is exploited by using a piece of apparatus i.e. ESDA designed especially for the purpose.



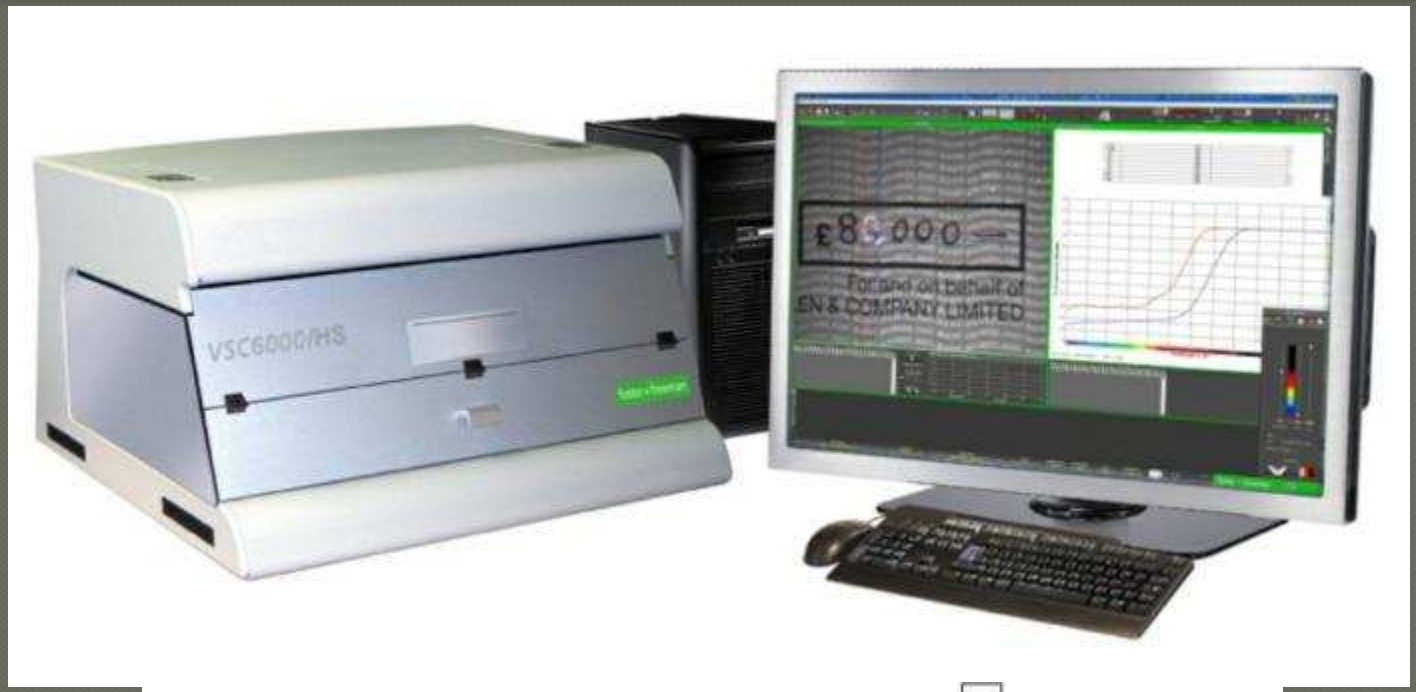
Electrostatic Detection Apparatus (ESDA)

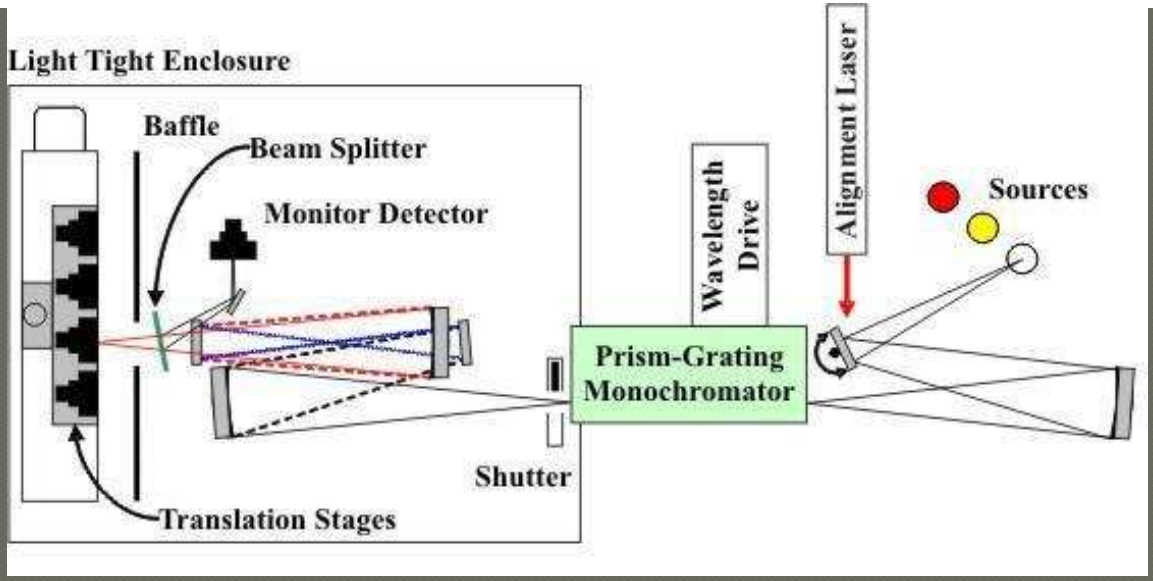


- Video Spectral Comparator (VSC) :

It is produced by Foster and Freeman Limited, U.K and has been designed especially for document examination. It contain all the apparatus in one unit which is required to detect the differences in inks on documents and paper. The apparatus incorporates a CCD camera (Which is very sensitive in the infrared region) a video monitor, light sources and filters for both the exciting radiation and the reflected or fluorescent light. This instrument is based on the principle of absorption theory. At different wavelengths, depending upon the ingredients and composition of the inks/ paper they can be differentiated. The VSC is capable of exploiting infrared absorption, infrared luminescence, U.V fluorescence and transmitted light to determine differences in inks on documents, texture of paper and examine alteration and obliteration ,chemical and mechanical erasures, indentations and to decipher the original writings and also to super impose the traced forgeries.

It is a non-destructive sensitive equipment capable of detecting any defects in the questioned documents.





Video Spectral Comparator (VSC)

LIGHT ARRANGEMENTS

- Incident light
- Oblique light
- Transmitted light
- UV
- IR
- Fluorescence Light

INTERACTION OF RADIATION WITH MATTER

When incident radiation of different wavelengths, such as Gamma rays, X rays, UV, VIS, IR, etc. falls on materials, usually the following phenomenon take place:

- Reflection
- Scattering
- Selective/ differential absorption
- Transmission
- Photo luminescence

Filter photography

- Visible reflection
- Helps in deciphering obscured writings on multi coloured surface.
- Careful observation/ photography through suitable filters provides proper contrast by suppressing/ highlighting some of the colours

IR REFLECTION PHOTOGRAPHY

- Helps to decipher the obliterated writings. If the obliterating ink/ dye is IR transparent and the host ink/dye is IR reflecting, the IR photography will reveal hidden writings

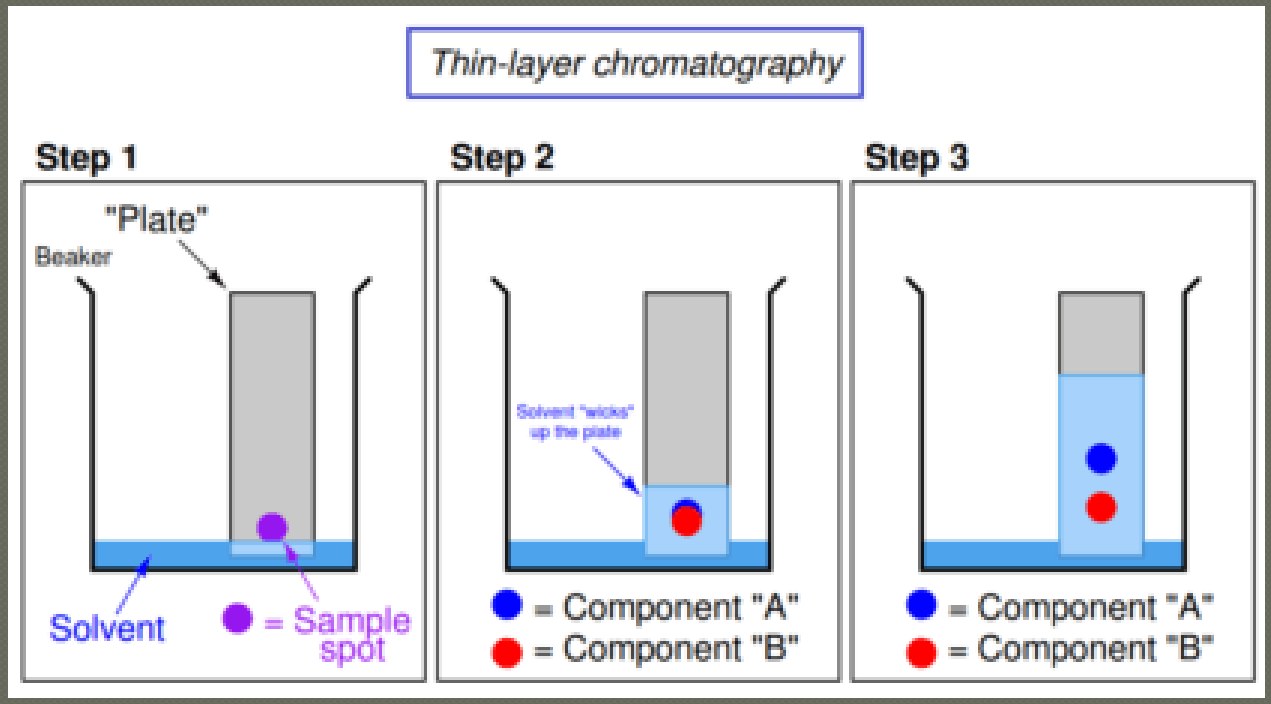
PHOTOLUMINESCENCE

- There are many substances which absorb radiation of one wavelength and in its place emit radiation of another wavelength. This phenomenon, in general, is called Photoluminescence.
- UV: Short wave and long wave UV
- IR: Incident light in visible region produces luminescence which can be detected in IR region. Useful in differentiation of inks, obliterations, alterations, overwriting, erasures.

Thin Layer Chromatography:

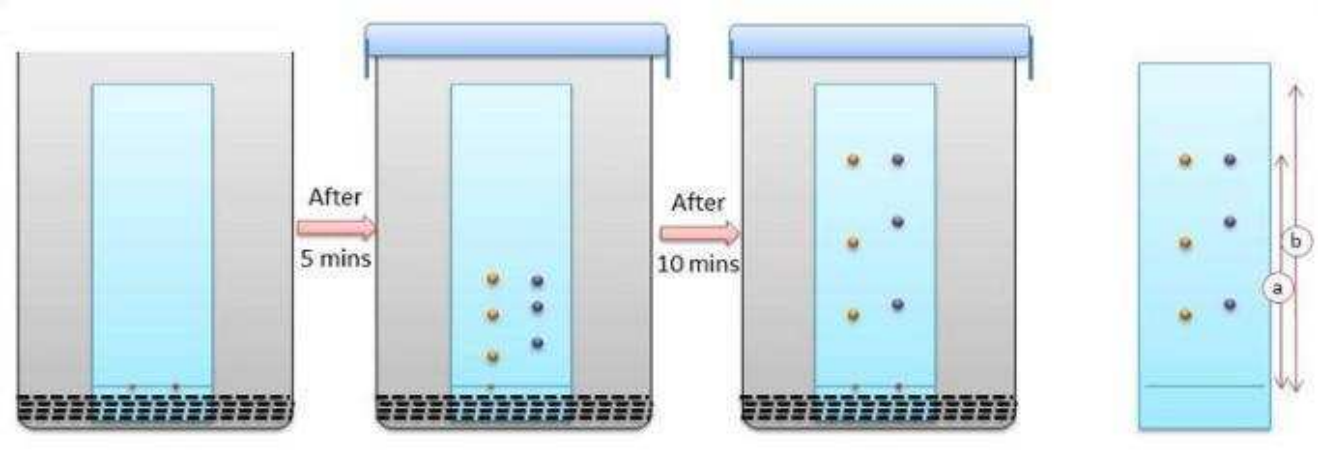
It is a technique used to isolate non-volatile mixtures. The experiment is conducted on a sheet of aluminium foil, plastic, or glass which is coated with a thin layer of adsorbent material (Stationary Phase). The material usually used is aluminium oxide, cellulose, or silica gel.

Mobile phase is the one that moves and consists of a solvent mixture or a solvent.



On completion of the separation, each component appears as spots separated vertically. Each spot has a retention factor (R_f) expressed as: R_f = dist. travelled by sample / dist. travelled by solvent

The factors affecting retardation factor are the solvent system, amount of material spotted, adsorbent and temperature. TLC is one of the fastest, least expensive, simplest and easiest chromatography technique. It depends on the separation principle.



High Performance Thin Layer Chromatography:

It is an advanced method of thin-layer chromatography (TLC). A number of enhancements can be made to the basic method of thin-layer chromatography to automate the different steps, to increase the resolution achieved, and to allow more accurate quantitative measurements.

Automation is useful to overcome the uncertainty in droplet size and position when the sample is applied to the TLC plate by hand.

Thank You