

## MEDICAL PHYSICS

### 5-3 Image enhancement

1. (a) (i) A contrast medium is one that is used to make the image of a particular organ or organs stand out.

(ii) For example:       barium sulphate to image the stomach

                                  Iodine to image blood vessels

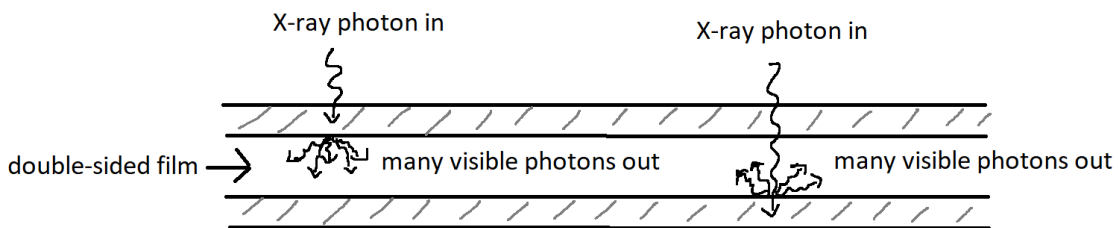
(iii) A lead collimator grid allows only X-rays that have passed directly through the patient to reach the X-ray film. Rays that have been scattered by the tissue and bone which reduce contrast are prevented from reaching the film. Lead is used because it is the most effective material at absorbing X-rays.

2. (a) (i) Beam definer plates are made of lead.

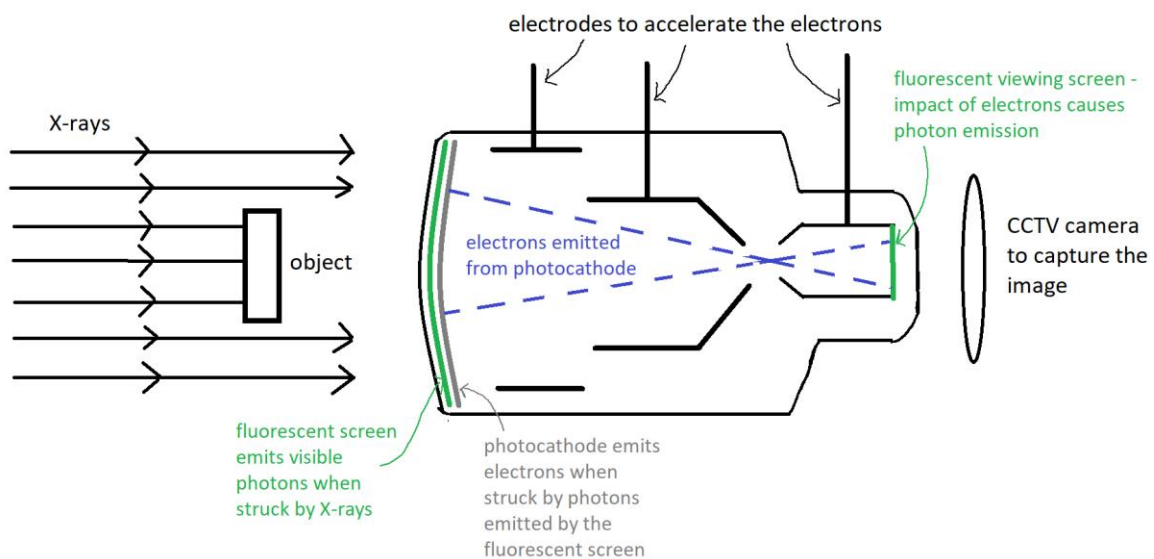
(ii) A filter to remove low-energy X-rays is made of copper, tin or lead.

(b) Copper and tin are not suitable for a beam definer as they do not absorb X-rays as well as lead.

3. (a) An intensifying screen is used to increase the rate at which the film darkens and reduce the patient's exposure time to the X-rays. Every X-ray photon that hits a fluorescent material like calcium tungstate or zinc sulphide and is absorbed leads to the emission of many photons of visible light which will darken the film. Encasing the film in a sandwich of two sheets of such a material hence makes the image form 30x more quickly with the film being exposed from both sides.



(b) (i)



(ii) The advantages of an image intensifier compared to an intensifying screen are:

- The image can be seen instantly
- The image can be captured on camera and can thus be sent for digital storage where it can be processed to make it sharper and clearer.

4. (a) The main differences between an X-ray CT scanner and an ordinary X-ray imaging system are:

- -A CT scanner does not take X-rays in a single orientation as in an ordinary X-ray but through 360° around the patient.
- The signals from detectors are recorded by computer and processed to give the image, it cannot be seen directly.
- The X-rays used are filtered to be monochromatic, not a range as in an ordinary X-ray.
- The energy range used in CT is 100 - 150 keV compared to 30 – 100 keV in an ordinary X-ray.

(b) An X-ray CT scanner has the advantage that it:

- provides a digital image unlike a film
- can provide depth information
- can be processed to give an image of any cross-section through the body
- images of parallel planes can be used to reconstruct a 3-D image of an organ