

SUMMARY

- X-rays are produced by the collision of electrons with a target material.
- Soft X-rays are less penetrating and have lower frequency than hard X-rays.
- A CT scan is produced by the computer analysis of the attenuation of X-rays moving around a slice of the body.
- A series of consecutive 2-D scans can be stored by the computer and combined to produce a 3-D image.
- CT scans can distinguish soft tissue with small differences in density and can produce an image of tissue behind bone.
- CT scans are expensive compared with conventional radiographs.
- CT scans can provide confirmation of suspected problems, such as tumours, damaged cartilage or internal bleeding.
- Endoscopes use optical fibres to transfer light to and from the inside of the body to enable internal structures to be seen.
- Non-coherent bundles of optical fibres transfer light to the inside of the body.
- An image is formed when light is transferred along coherent bundles of optical fibres from inside the body to the light receptor.

QUESTIONS

- Outline the property of electrons that allows them to be focused using electric and magnetic fields but prevents X-rays from being focused.
- X-rays used for diagnosis are generated with tube voltages of about 70 kV compared with several megavolts when X-rays are needed to destroy tissue.
 - State what is meant by 'diagnosis'.
 - Outline the effect that X-rays produced with tube voltages of several megavolts will have on body tissue.
- With the aid of a labelled diagram, give a description of the way in which X-rays are produced.
- For a typical X-ray tube with a tungsten target:
 - sketch a graph that shows how the intensity of the resulting X-radiation varies with photon energy
 - explain (i) the range of frequencies obtained and (ii) the sharp peaks on your graph
 - redraw the graph to show how it would be changed if some soft X-rays were removed by filtering.
- Outline how the attenuation of X-rays changes for different materials in the body.
 - Describe and account for the appearance of an X-ray image of part of the body containing bone, muscle and air spaces.
- State a difference between ultrasound and X-rays and outline why this difference is important for the way each is used.
- Use a table to compare hard and soft X-rays.
- This question refers to figure 19.15 on page 373. Assume the external medium is air.
 - Explain what is meant by the 'critical angle' of a material.
 - Outline why a critical angle is important in an optical fibre.
 - Describe the function of the cladding in an optical fibre.
 - State the relationship between the refractive index of the cladding and the refractive index of the core of the fibre.
- Describe how the fibres are positioned in a coherent bundle.
 - Explain why a coherent bundle is necessary in an endoscope.
 - Explain why the endoscope has to be used in conjunction with a powerful light source.
 - Which properties of the fibre bundle affect the ability of the observer to see small details when using the instrument?
- 'The main principle behind the operation of an endoscope is the transfer of light to and from the internal organs of the body.' Evaluate this statement.
- Use a table to summarise situations in which CT scans are a superior diagnostic tool to X-rays or ultrasound. For each situation, outline why X-rays and ultrasound are inferior.
- An endoscope is used to take a biopsy of a small tumour in the oesophagus, which leads from the mouth to the stomach. Explain how an endoscope can be used to do this.
- Explain how an endoscope could be used to examine and repair a torn ligament inside the knee joint.

14. Examine the image of the lungs taken by an X-ray (figure 19.1 on page 361) and a CT scan of the upper leg (figure 19.13 on page 371). Compare the information provided by each image.
15. Find at least three different X-rays images on the internet, using key words such as 'X-ray image of fracture', 'mammogram', 'barium meal X-ray', 'lung X-ray'. Outline why X-rays have been successful in producing the image in each case.
16. From the internet or other sources, find at least three images of internal organs obtained by using an endoscope. If searching the Internet, use key words such as 'laparoscopy images' or 'colonoscopy images'. For each image, describe the internal organ as viewed from the endoscope.
17. (a) Describe how a CT scan is obtained.
(b) Outline why improvement in computer technology is linked strongly with clearer CT scans.
18. From the internet or other sources, find at least three different images of the body obtained using CT scanning. For each image, describe the detail that is visible and outline how the image would be different if ultrasound or X-rays were used.