Q1.

(a) **Figure 1** shows an X-ray image of a chest on photographic film.
Figure 2 shows a diagram of a horizontal cross-section of the chest along the dashed line in **Figure 1**.

Figure 1

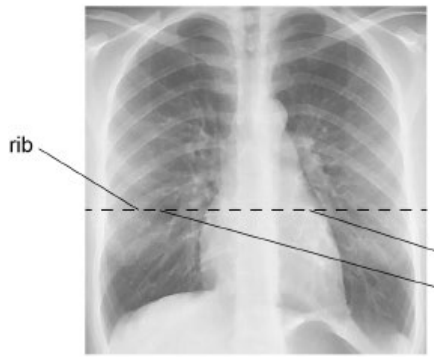
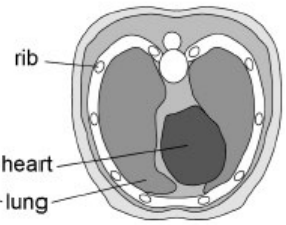


Figure 2



Discuss the half-value thicknesses of the labelled body parts relative to each other.

In your answer you should:

- explain how the intensity of the X-rays affects the brightness of the image
- explain how the thickness of the labelled parts affects the intensity of the X-rays
- compare the relative half-value thicknesses of the labelled body parts.

(6)

(b) The stomach is not clearly visible in **Figure 1**.

Explain the method used to improve the image of the stomach on X-ray photographic film.

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(2)

(Total 8 marks)

Q2.

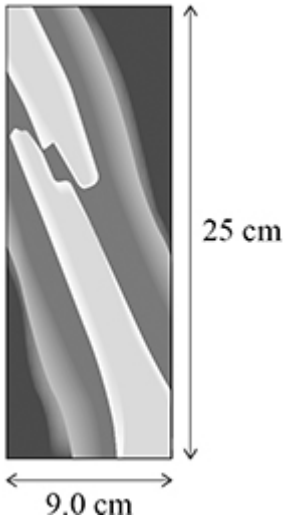
(a) An X-ray image is to be made of a broken bone.
The image can be formed on

- photographic film
- a flat panel (FTP) detector or
- an intensifying screen using fluoroscopic image intensification.

State and explain which one of these detection methods should be used in this situation.
Go on to discuss why the other two methods are less suitable.

(4)

The figure below shows an X-ray of a broken bone.



mean diameter of bone = $0.040\ \text{m}$

intensity of incident X-rays = $0.013\ \text{W m}^{-2}$

exposure time of X-ray = $0.80\ \text{s}$

linear attenuation coefficient of bone = $58.3\ \text{m}^{-1}$

(b) Calculate an estimate for the X-ray energy that is absorbed by the bone.

energy absorbed = _____ J

(5)

(c) State **two** reasons why the estimate of energy absorption in part (b) may be greater than the actual value.

1. _____
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2. _____
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(2)

(Total 11 marks)

Q3.

A patient has calcium kidney stones.
Three types of scan are available to investigate the condition:

- a magnetic resonance (MR) scan
- a CT scan
- an ultrasound scan.

Calcium kidney stones contain no water and appear similar to bone in each of the scans.

Discuss the advantages and disadvantages of each option.
In your answer you should

- refer to the relevant quality of the image obtained from each scan
- identify other factors that should be considered
- justify the type of scan you would recommend.

(Total 6 marks)