9 **(a)** Electrons in a vacuum are accelerated through a potential difference of 84 kV. The electrons then strike a metal target and X-rays are produced.

(i) Calculate the minimum wavelength of the X-rays that are produced.

wavelength = ... m [2]

(ii) The melting points of two metals are given in Table 9.1.

Table 9.1

metal	melting point / °C
copper	1090
tungsten	3420

Suggest why the metal target is made from tungsten rather than copper.

....

....

.... [2]

(b) An X-ray beam is incident normally on a sample of soft tissue and bone as shown in Fig. 9.1.

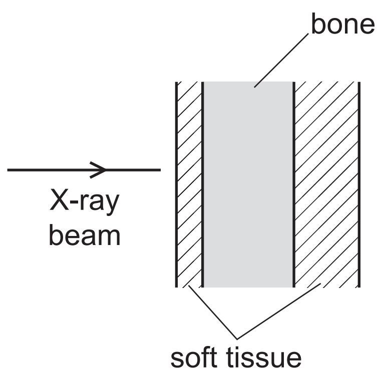

Fig. 9.1

Data for the two materials are given in Table 9.2.

Table 9.2

medium	linear attenuation coefficient μ / cm^{-1}	specific acoustic impedance Z / $10^6\,kg\,m^{-2}\,s^{-1}$
soft tissue	0.22	1.7
bone	3.0	7.8

The total thickness of soft tissue is x. The total thickness of bone is also x.

The incident intensity of the X-ray beam is I_0. The transmitted intensity of the X-ray beam is 13% of the incident intensity.

Determine x, in cm.

x = ... cm [3]

(c) **(i)** Define the specific acoustic impedance of a medium.

....

....

.... [2]

(ii) Use data from Table 9.2 to calculate the percentage of the intensity of ultrasound that is transmitted at a boundary between soft tissue and bone.

percentage transmitted = ... % [2]

(iii) The ultrasound is now incident on the sample of soft tissue and bone shown in Fig. 9.1.

Suggest **two** reasons why the transmitted intensity through the sample is less than the answer in **(c)(ii)**.

1 ....

....

2 ....

....
[2]

[Total: 12]