10 (a) Define specific acoustic impedance.

[2]

(b) Explain how ultrasound waves are detected by a piezoelectric crystal.

[2]

(c) Table 10.1 shows the specific acoustic impedance *Z* for body tissue, water and steel.

Table 10.1

material	Z / kg m^{-2} s^{-1}
body tissue	1.38×10^{6}
water	1.48×10^{6}
steel	4.04×10^{7}

(i) Calculate the intensity reflection coefficient for ultrasound incident on a water–steel boundary.

intensity reflection coefficient = ... [2]

(ii) Explain, without calculation, what is likely to happen when ultrasound is incident on a body tissue–water boundary.

[2]

[Total: 8]

10 (a) Describe how the piezoelectric crystal in a transducer generates ultrasound waves for use in medical diagnosis.

[3]

(b) A parallel ultrasound beam is incident on the boundary between two media, as illustrated in Fig. 10.1.

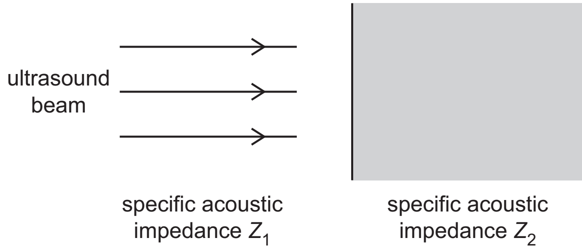

Fig. 10.1

The media have specific acoustic impedances Z_1 and Z_2.

At the boundary, a fraction α of the incident intensity of the ultrasound beam is reflected. The remainder is transmitted.

(i) State what is meant by specific acoustic impedance.

[2]

(ii) Describe how α depends on the relative values of Z_1 and Z_2.

[2]

(c) A parallel ultrasound beam of intensity I_0 enters a region of soft tissue. After passing a distance of 2.1 cm through this tissue, the intensity of the ultrasound is $0.62 I_0$.

Calculate the linear attenuation coefficient μ of ultrasound in the soft tissue. Give a unit with your answer.

μ = ... unit .... [2]

[Total: 9]