

10 (a) Define specific acoustic impedance.

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..... [2]

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

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..... [2]

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

Table 10.1

material	$Z/\text{kg m}^{-2}\text{s}^{-1}$
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.

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..... [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.

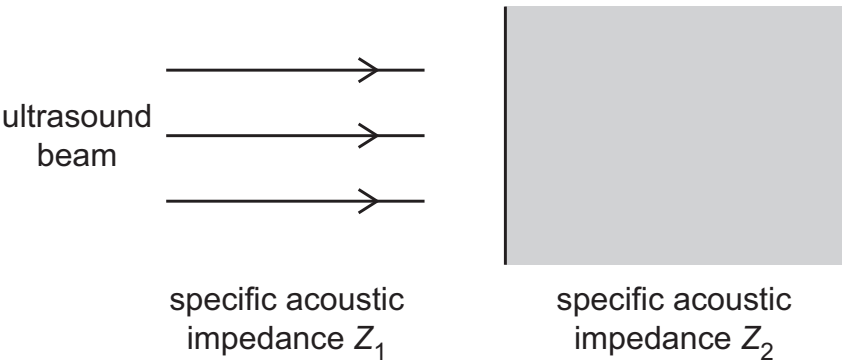


Fig. 10.1

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 $0.62I_0$.

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

$\mu = \dots\dots\dots$ unit $\dots\dots\dots$ [2]

[Total: 9]