

Medical Imaging 2

1.

- (a) Describe the
- piezoelectric effect*
- .

.....
 [1]

- (b) Describe how ultrasound scanning is used to obtain diagnostic information about internal structures of a body. In your description include the differences between an A-scan and a B-scan.

.....

 [4]

- (c) Fig. 7.1 shows the speed of ultrasound, density and acoustic impedance for muscle and bone.

material	speed of ultrasound / m s^{-1}	density / kg m^{-3}	acoustic impedance / $10^6 \text{ kg m}^{-2} \text{ s}^{-1}$
muscle	1590	1080	1.72
bone	4080	1750	7.14

Fig. 7.1

- (i) Show that the unit for acoustic impedance is
- $\text{kg m}^{-2} \text{ s}^{-1}$
- .

[1]

- (ii) An ultrasound pulse is incident at right angles to the boundary between bone and muscle. Calculate the fraction of reflected intensity of the ultrasound.

fraction of reflected intensity = [2]

- (iii) What is meant by *acoustic impedance matching*? Explain why a gel is used to produce an effective ultrasound image.

.....
.....
.....
..... [2]

- (iv) The frequency of the ultrasound in the muscle is 1.2 MHz. Calculate the wavelength of the ultrasound in millimetres (mm).

wavelength = mm [2]

- (v) Suggest why it is desirable to have ultrasound of short wavelength for a scan.

.....
.....
..... [1]

2.

- (a) State one reason for using non-invasive techniques in medical diagnosis.

.....
..... [1]

- (b) Describe the use of medical tracers to diagnose the condition of organs.

.....
.....
.....
..... [2]

.....
.....
.....
.....
.....
..... [4]

(b) Explain the difference between an ultrasound A-scan and B-scan.

.....
.....
.....
..... [1]

4.

(a) In the treatment of patients, explain what is meant by a non-invasive technique. State one of its advantages.

.....
.....
..... [2]

(b) Explain what is meant by a medical tracer. Name a medical tracer commonly used to diagnose the function of organs.

.....
.....
..... [2]

- 

[5]

-
- A schematic diagram showing an optical Doppler probe in contact with a patient's skin. The probe consists of a cylindrical body with a 'transducer' at the tip, which is shown pressing into a layer of 'gel' on the 'patient's skin'. Below the skin, a cross-section of an 'artery' is visible, containing 'red blood cells'. An arrow indicates the 'direction of blood flow' within the artery.

(i) The speed of ultrasound in blood is 1500 m s^{-1} . Calculate the wavelength of the ultrasound of frequency $2.0 \times 10^6 \text{ Hz}$.

wavelength = m [2]

(ii) Describe how the ultrasound is used to determine the speed of the blood in the artery.

.....

.....

.....

.....

.....

.....

.....

..... [3]
