Support Worksheet – Option I, Worksheet 2

1 Calculate the acoustic impedance of soft tissue of density $1.04\times10^{3}\ \text{kg m}^{-3}$ where the speed of sound is $1560\ \text{m s}^{-1}$. [1]

2 When a wave travelling in a medium of impedance Z_1 is incident on a medium of impedance Z_2 the fraction of the incident intensity that is reflected (the reflection coefficient) is given by $R=\left(\frac{Z_1-Z_2}{Z_1+Z_2}\right)^2$. State what fraction of the incident intensity is reflected when the two media have:

a approximately the same impedance. [1]

b very different impedances. [1]

3 State one reason why ultrasound cannot be used to obtain a good image of the brain of an adult. [1]

4 Ultrasound of frequency 2.0 MHz is to be used for imaging purposes in tissue. The speed of sound in tissue is $1560\ \text{m s}^{-1}$. Estimate the resolution (i.e. the smallest length that can be seen) in this type of imaging. [2]

5 State an advantage of the use of the laser as a scalpel over a conventional scalpel. [1]

6 In the context of radiation dosimetry define the terms:

a **exposure**. [1]

b **absorbed dose**. [1]

c **quality factor** (relative biological effectiveness). [1]

d **dose equivalent**. [1]

7 Distinguish between physical half-life and biological half-life. [2]

8 Calculate the effective half-life of an isotope with a physical half-life of 2 days and a biological half-life 12 days. [2]

9 A patient of mass 72 kg is injected with a quantity of technetium 99 whose average activity while in the body is 380 MBq. Technetium 99 decays by gamma emission. The energy of the photons emitted in the decay of technetium is 140 keV. The radioactive material remains in the body for 6 hours. Calculate the dose equivalent received by this patient. (The quality factor for gamma radiation is 1.) [4]