1. Nov/2021/Paper_41/No.11

(a) State, for an X-ray image, what is meant by:

(i) *sharpness*

....

.... [1]

(ii) *contrast*.

....

.... [1]

(b) A parallel X-ray beam passes through a thickness of 2.3 cm of soft body tissue. The intensity of the emerging beam is 12% of the intensity of the incident beam.

Calculate the linear attenuation (absorption) coefficient μ of the soft body tissue. Give a unit with your answer.

$\mu =$ .... unit .... [3]

(c) In medical diagnosis, X-rays may be used to produce a single X-ray image or may be used in computed tomography (CT scanning).

Suggest an advantage and a disadvantage of CT scanning compared with single X-ray imaging for diagnosis.

advantage: ....

....

disadvantage: ....

....

[2]

[Total: 7]

(a) A piezoelectric transducer containing a quartz crystal is used to obtain diagnostic information about internal structures.

Describe the function of the quartz crystal.

....

....

....

.... [3]

(b) (i) Define *specific acoustic impedance*.

....

....

.... [2]

(ii) Describe, qualitatively, how the specific acoustic impedances of two materials affect the intensity reflection coefficient at a boundary between the materials.
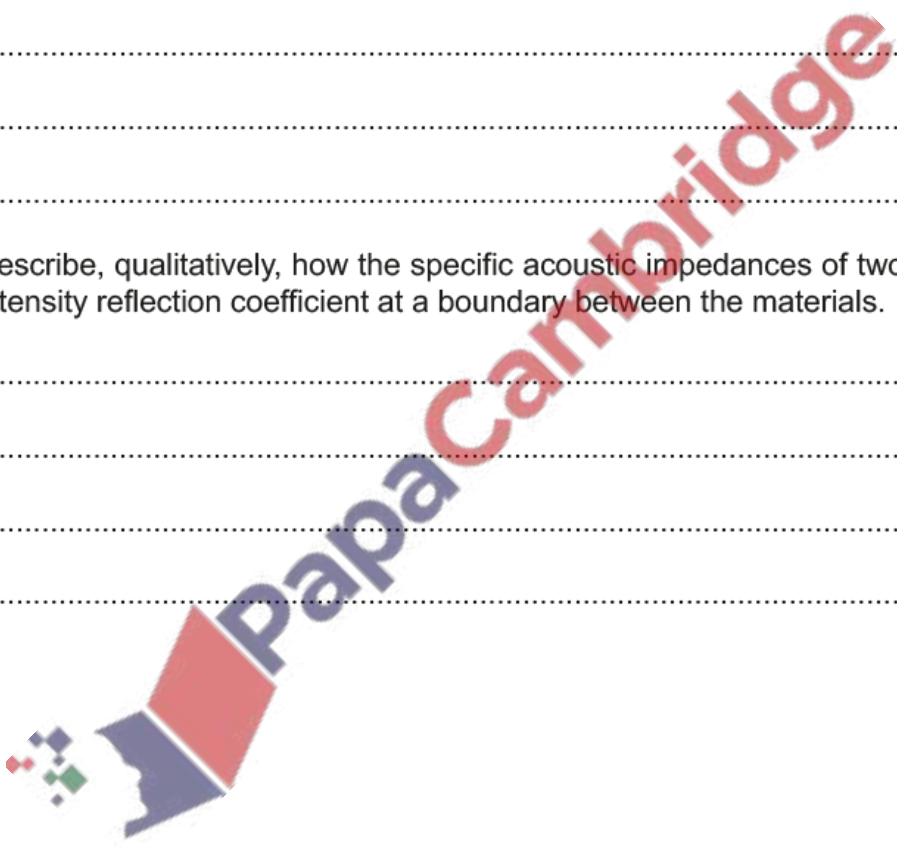
....

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.... [2]

[Total: 7]

3.

Outline the **use** of ultrasound to obtain diagnostic information about internal body structures.

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.... [5]
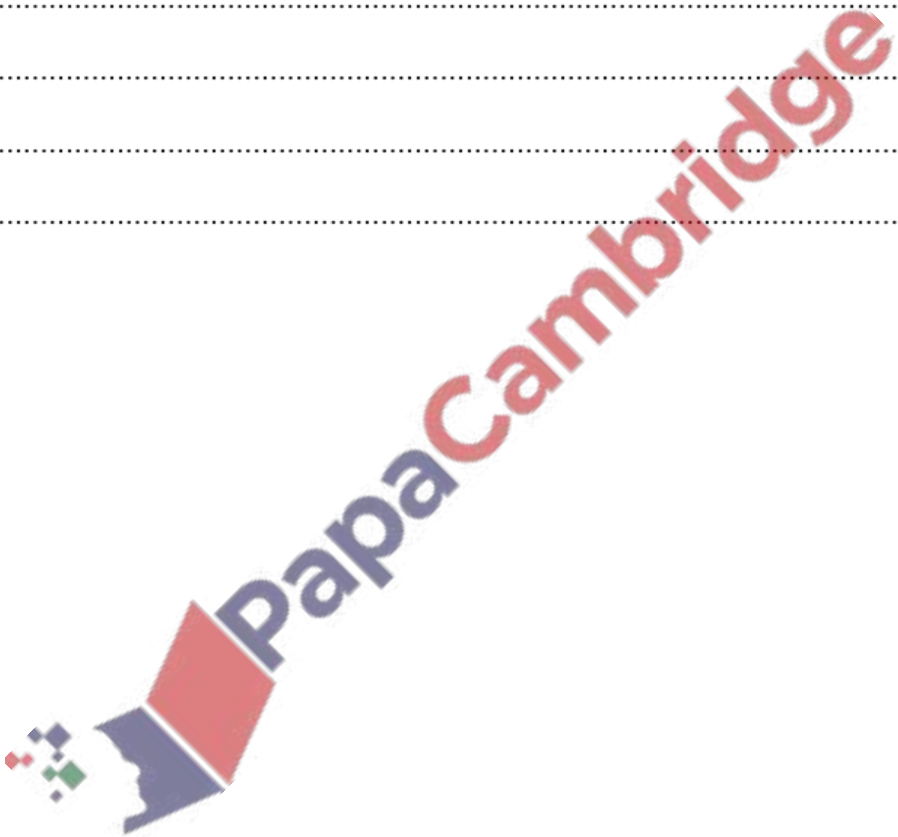
4.

(a) State how, in a modern X-ray tube, the intensity of the X-ray beam and its hardness are controlled.

intensity: ....

....

hardness: ....

....

[2]

(b) A model of a limb consists of soft tissue and bone, as illustrated in Fig. 11.1.
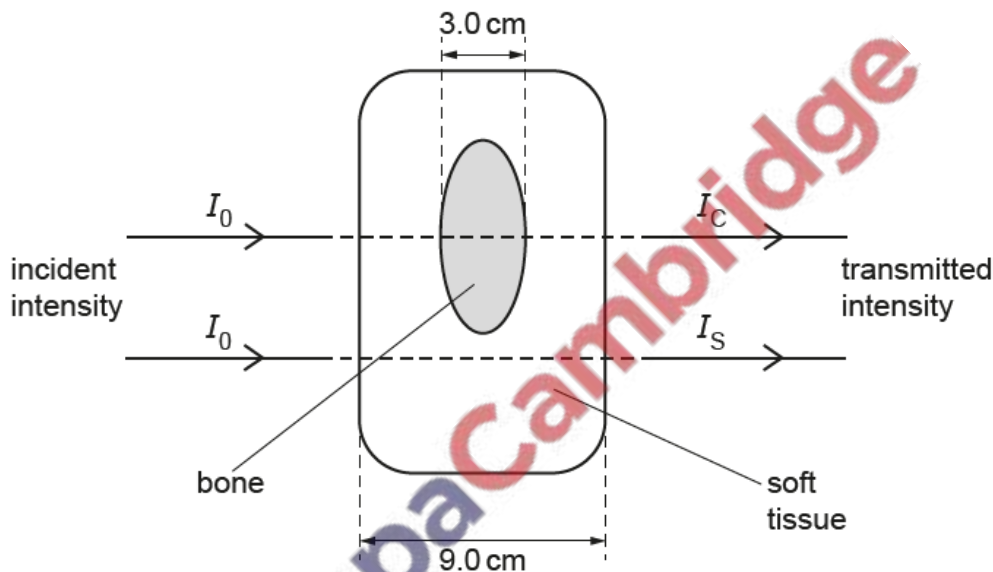

Fig. 11.1

The soft tissue has a thickness of 9.0 cm. The bone within the soft tissue has a thickness of 3.0 cm.

Data for the linear attenuation (absorption) coefficient μ of X-rays in soft tissue and in bone are shown in Table 11.1.

Table 11.1

	μ/cm^{-1}
soft tissue	0.92
bone	2.9

A parallel beam of X-rays of intensity I_0 is incident normally on the model.

Calculate, in terms of I_0:

(i) the transmitted intensity I_S through soft tissue alone

I_S = ... I_0 [2]

(ii) the transmitted intensity I_C through soft tissue and bone.

I_C = ... I_0 [2]

(c) By reference to your answers in (b), suggest, with a reason, whether good contrast on an X-ray image would be obtained.

....

.... [1]

[Total: 7]

5.

(a) State the purpose of computed tomography (CT scanning).

....

.... [1]

(b) Outline the principles of CT scanning.

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.... [5]

[Total: 6]