

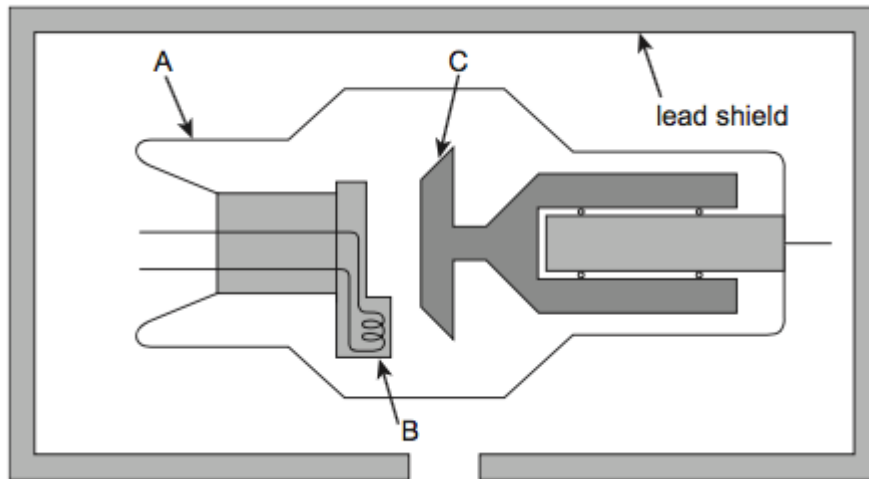
Name of the Student: _____

Max. Marks : 18 Marks

Time : 18 Minutes

Q1.

The diagram shows a simplified modern X-ray tube with a rotating anode.



- (a) Explain the design and operation of the X-ray tube and the purposes of the components labelled on the diagram.

In your answer you should include:

- reference to the components labelled A, B, C and the lead shield
- an explanation of the physical processes by which X-rays are produced.

The quality of your written communication will be assessed in your answer.

(6)

(b) The X-ray tube produces photons of energy 50 keV. The half-value thickness of bone for photons of this energy is 15 mm.

(i) Explain what is meant by half-value thickness.

(1)

(ii) Show that for 50 keV X-ray photons, the attenuation coefficient of bone μ is 0.046 mm^{-1} .

(1)

(iii) A beam of 50 keV X-ray photons is incident on a bone of thickness 12 mm. Calculate the percentage of the incident photons that leave the far side of the bone.

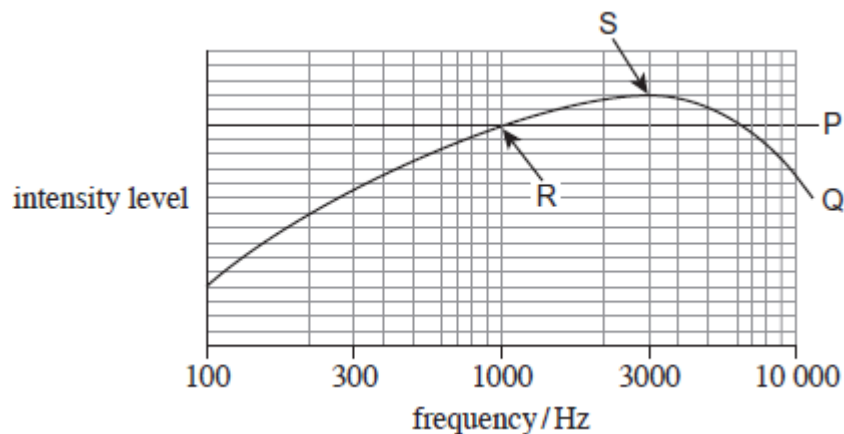
percentage of incident photons = _____ %

(2)

(Total 10 marks)

Q2.

(a) A variable-frequency sound source produces sound of equal intensity at all frequencies. Two sound meters are placed at equal distances from the source. The two meters are set on different scales. Lines P and Q on the graph show how the intensity level indicated by each meter varies with frequency.



(i) State and explain which sound meter scale is used for line P.

(2)

(ii) State and explain which sound meter scale is used for line Q.

(2)

(b) (i) Explain the significance of the point R.

(1)

(ii) Explain the significance of the point S.

(1)

(c) A sound of intensity level 95 dB is incident on a human ear.
Calculate the intensity incident on the ear drum.

$$I_0 = 1.0 \times 10^{-12} \text{ W m}^{-2}$$

intensity = _____ W m^{-2}

(2)

(Total 8 marks)