Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Mark Schemes

Q1.

(a) Points to be considered:
A – glass envelope. This is needed to allow low pressure within the tube
B – heated cathode. Heated to provide thermionic emission of electrons from the surface
C – anode. Used to accelerate electrons across the gap between cathode and anode.
lead shielding - Prevents much of the emission in unwanted directions.
The anode rotates to allow heat to be dissipated over greater area and thus allows longer use without over-heating. The anode is bevelled to allow a larger 'target' area for the electrons, whilst also producing a smaller 'source' area for the photons in the required direction.
Low pressure is required in the tube to allow the electrons to be accelerated across the gap without colliding with gas atoms and losing energy in the collision.
Electrons colliding with anode material excite / ionise the atoms and as the atoms de-excite X-ray photons of specific energies are produced.
Electrons can also be decelerated as they pass through the anode. The energy of the X-ray photon is equal to the energy lost by the decelerated electron. This can be any value from the max energy of the electron to zero. This produces a continuous background spectrum of X-ray photon energies.
Good candidates will name and state the use of the labelled components and will expand on a property of the anode and suggest why some X-rays are produced.
Middle candidates will name and state the use of 3 or all of the labelled components. They may try to expand on the anode properties or the method of X-ray production.
Poor candidates may be able to name some labelled components, but will fail to apply the ideas.

6

(b) (i) Thickness of material needed to reduce (beam) intensity by half

Accept (beam) power NOT energy

1

(ii) ln2 / 15 = 0.046

Use of 50 and 25 is EOP

1

(iii) $\% I^T / I_0 = e^{-(0.046 \times 12)} \times 100$
= 58 %

If 0.0462 is used, the answer 57.4 or 57 is correct

1
1

[10]

Q2.

(a) (i) The dB scale

Allow decibel scale Not DB

1

Equal response across all frequencies

Allow unaffected by / independent of frequency

1

(ii) The dBA scale

Allow adjusted / adapted decibel scale Not DBA

1

Response depends upon **frequency** as **ear's response** does

1

(b) (i) Point R has equal values on both scales (as 1kHz) is the frequency used to define threshold value

Allow reference frequency for dBA scale

1

(ii) Point S is at (3kHz as this is) the frequency at which the ear is most sensitive

Allow most sensitive as at peak of curve

1

(c) $I = 1.0 \times 10^{-12} \times 10^{9.5}$

First mark for any correct initial equation

1

$I = 3.2 \times 10^{-3}$ (W m^{-2})

Only penalise 1 sig fig

1

[8]