

Name of the Student: _____

Max. Marks : 23 Marks

Time : 23 Minutes

Q1.

- (a) The fovea in a typical human eye consists of cones which have an average diameter of 1.5×10^{-6} m

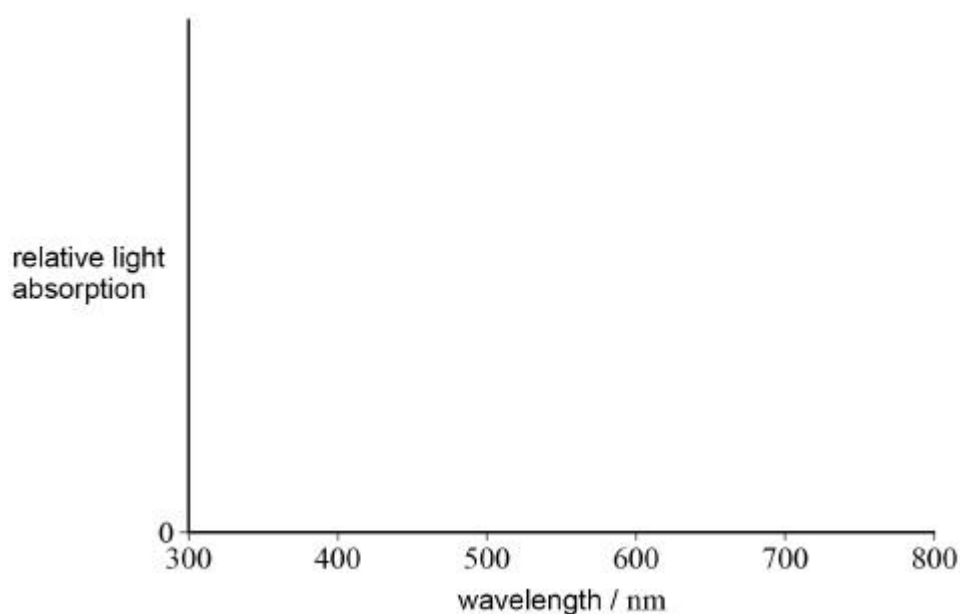
An eye looks directly at two point sources of light which are 12 mm apart at a distance of 61 m from the centre of the eye lens. The fovea is at the centre of the retina a distance of 21 mm behind the centre of the eye lens.

Deduce whether the eye would be able to resolve the two images formed at the fovea.

(4)

- (b) Three types of cone are present at the fovea.

On the axis below sketch and clearly label **three** curves to show how the relative light absorption of each type of cone varies with wavelength.



(3)

- Discuss how these scans are used to help provide the best and safest treatment for the patient when using the high-energy X-rays.

[illegible]

(b) Lead is commonly used as shielding when using X-rays due to its small half-value thickness.

Which statement gives the correct meaning of half-value thickness?

Tick (✓) the correct answer.

The thickness of material needed to reduce the energy of an X-ray photon by half.

9

The thickness of material needed to reduce the wavelength of the photons in the X-ray beam by half.

3

The thickness of material needed to reduce the intensity of the X-ray beam by half.

Half the thickness of material needed to stop the X-ray beam.

20

(c) The half-value thickness of lead for 500 keV X-rays is 4.2×10^{-3} m

Calculate the mass attenuation coefficient of lead for 500 keV X-rays.

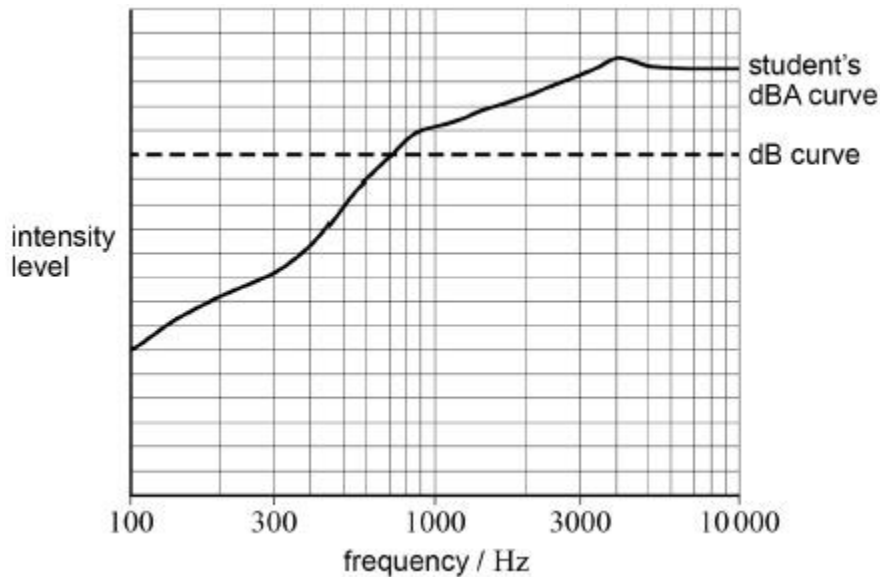
State an appropriate unit for your answer.

density of lead = $1.1 \times 10^4 \text{ kg m}^{-3}$

Q3.

- (a) A source of constant output power is used to generate a sound which is measured using a sound meter.

The dashed line in the graph shows the intensity level curve over a range of frequencies with the meter set to the dB setting.



A student sketches a curve, over the same frequency range, which he thinks would be obtained when the meter is changed to the dBA setting. The curve drawn by the student is shown as the solid line in the graph.

Discuss whether the dBA curve drawn is correct.

[illegible]

(4)

- (b) Mesh barriers are set up to keep pedestrians at a safe distance from a noisy drill. The maximum noise level which pedestrians should be subjected to is 110 dB

The drill emits sound with a power of 7.8 W and acts as a point source.
The mesh barriers are set up a distance of 2.0 m from the drill.

Discuss whether this will keep pedestrians at a safe distance from the sound source.

(4)
(Total 8 marks)