Section B

Answer **one** question from this Section in the spaces provided.

7 **(a)** Explain what is meant by a *progressive longitudinal wave*

Progressive ……………………………………………………………………………………..

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Longitudinal ………………………………………………………………………………………..

……………………………………………………………………………………………………[2]

(b) Fig. 7.2 shows the variation of displacement *y* with time *t* of a sound wave incident on a person's ear drum.
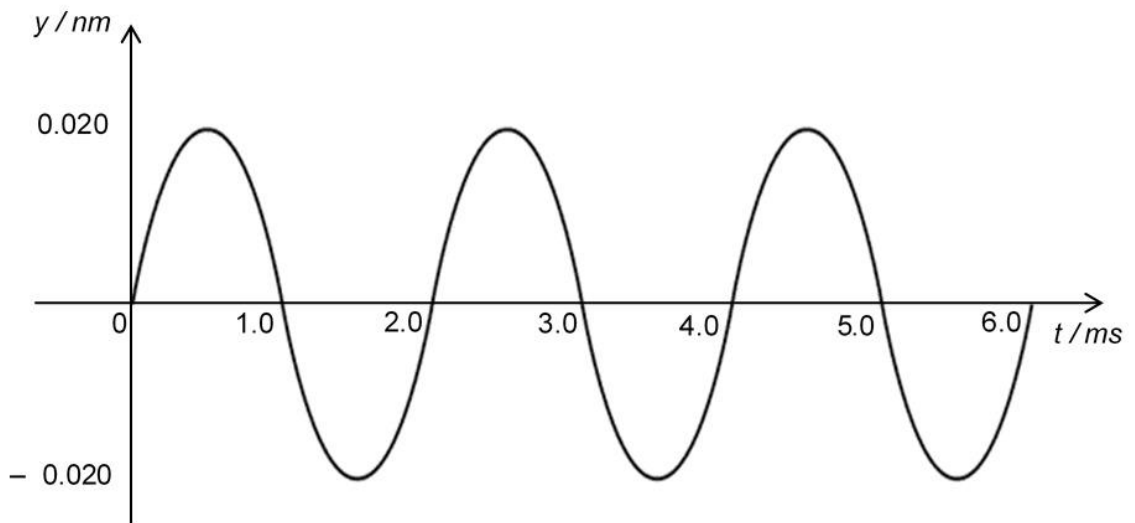

Fig. 7.2

Assume that the eardrum vibrates with simple harmonic motion and with the same frequency and amplitude as the incident sound wave.

**(i)** Determine the amplitude and frequency of the oscillating eardrum.

amplitude = ……………………………………………. m [1]

frequency = …………………………………………….. Hz [1]

(ii) Show maximum speed of the oscillating eardrum is 6.3×10^{-8} m s^{-1}.

[1]

(iii) Determine the mass of a human eardrum if the maximum kinetic energy of the oscillating eardrum is 2.4×10^{-19} J.

mass = …………….……………………………. kg [2]

(iv) On the axes of Fig. 7.3, sketch a clearly labelled graph to show the variation of the velocity of the ear drum v with displacement y.

v / m s^{-1}

0

y / nm
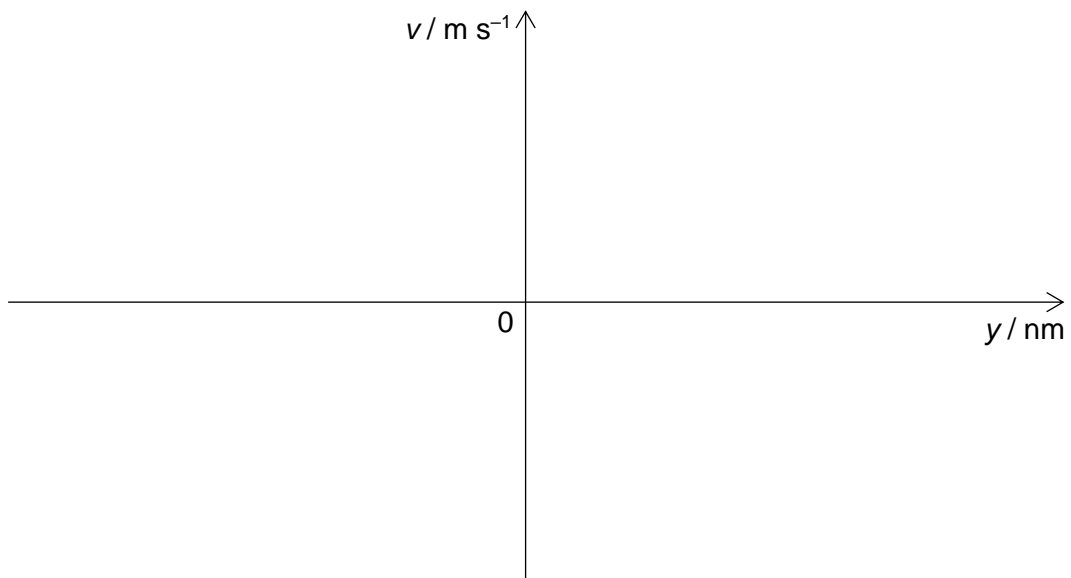
Fig. 7.3

[2]

(c) Hummingbirds can hover around flowers by beating their wings at a frequency between 20 and 80 times per second. It can be assumed that the air molecules around the birds vibrate at the same frequency.

(i) Deduce why a person standing near a hovering hummingbird may hear a buzzing sound.

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[Turn over

(ii) A bird watcher is initially 2.0 m from a hummingbird. To pick up a louder buzz, the bird watcher moves nearer to the bird by a distance *x*. Determine the value of *x,* in metres, for an increased intensity of 60%.

x = ……………………………………………….. m [3]

(iii) It is assumed that for a hummingbird which beats its wings at 75 times per second, the air molecules around it can vibrate in simple harmonic motion at an amplitude of 5.0×10^{-9} m. Calculate the distance covered by an air molecule over the duration in which the hummingbird beats its wings for 1800 times.

distance = …………………………………………… m [2]

(iv) Another bird watcher dislikes the buzzing sound and uses noise-cancelling technology to generate certain frequencies to cancel out the buzzing sound. Explain how the generation of such frequencies could cancel out the buzzing sound.

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