4 **(a)** State what is meant by a *longitudinal* wave.

.....

..... [1]

(b) Fig. 4.1 shows the equilibrium positions of 14 equally spaced air molecules, labelled 1 to 14, along a line AB. The separation between two adjacent equilibrium positions is 0.020 m.

When a point source of sound located on the left of A is switched on, a sinusoidal sound wave travels through the air at a speed of 343 m s^{-1}.

At time t = 0 s, air molecule 4 is at its maximum displacement towards the right from its equilibrium position, while air molecule 8 is the closest molecule that is at its maximum displacement towards the left.

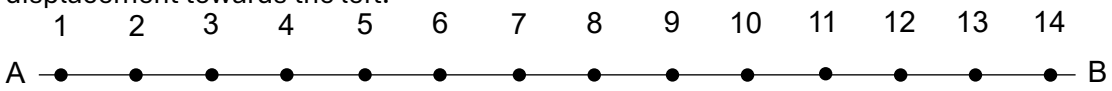

Fig. 4.1

(i) Determine, for the sound wave,

1. its wavelength

wavelength = ... m [1]

2. its frequency

frequency = ... Hz [1]

(ii) Label, on Fig. 4.1, with the letter C a point of compression, and the letter R a point of rarefaction.

[1]

(iii) On the axes in Fig. 4.2, sketch the variation with time *t* of the displacement *y* of air molecule 9 for one period of the wave.

Fig. 4.2

[1]

(iv) The power of the source is *P*. The intensity of sound recorded by a small detector placed 0.25 m away from the source along AB is I. The detector is then shifted further away along AB until it records an intensity of ½ I.

Determine the distance moved by the detector.

distance = ... m [2]