4 **(a)** State what is meant by the *frequency* of a progressive wave.

.....

.....

.....[2]

(b) A cathode-ray oscilloscope (c.r.o.) is used to determine the frequency of the sound emitted by a loudspeaker. The trace produced on the screen of the c.r.o. is shown in Fig. 4.1.

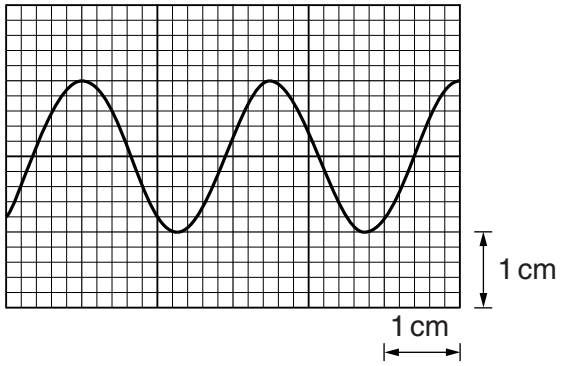

Fig. 4.1

The time-base setting of the c.r.o. is $250\,\mu s\,cm^{-1}$.

Show that the frequency of the sound wave is 1600 Hz.

[2]

(c) The loudspeaker in **(b)** emits the sound in all directions. A person attaches the loudspeaker to a string and then swings the loudspeaker at a constant speed in a horizontal circle above his head.

An observer, standing a large distance away from the loudspeaker, hears sound of maximum frequency 1640 Hz. The speed of sound in air is $330\,m\,s^{-1}$.

(i) Determine the speed of the loudspeaker.

speed = ... $m\,s^{-1}$ [2]

(ii) Describe and explain, qualitatively, the variation in the frequency of the sound heard by the observer.

.....

.....

.....

.....

.....[2]

[Total: 8]

5 **(a)** State what is meant by the *diffraction* of a wave.

.....

.....[2]

(b) Laser light of wavelength 500 nm is incident normally on a diffraction grating. The resulting diffraction pattern has diffraction maxima up to and including the fourth-order maximum.

Calculate, for the diffraction grating, the minimum possible line spacing.

line spacing = ... m [3]

(c) The light in **(b)** is now replaced with red light. State and explain whether this is likely to result in the formation of a fifth-order diffraction maximum.

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.....[2]

[Total: 7]