

APOLLO

Doppler effect

HL

Physics

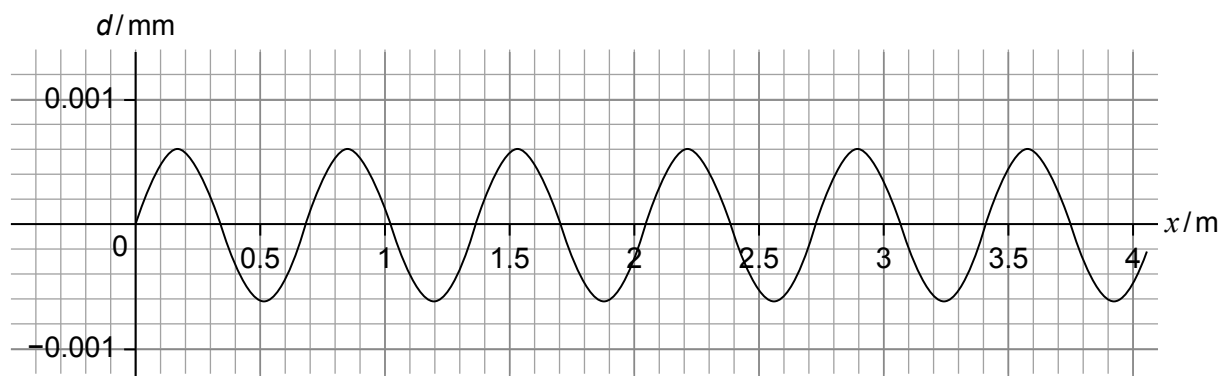
First assessment 2025

3 questions | questions

4. (a) Identify **two** differences between sound waves in air and light waves. [2]

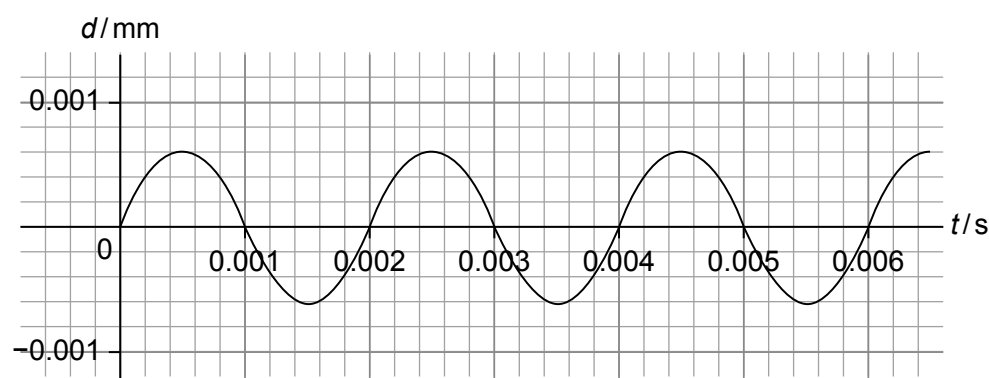
Graph 1 shows the variation of particle displacement d with position x for a travelling sound wave.

Graph 1



Graph 2 shows the variation of particle displacement d with time t for the same travelling sound wave.

Graph 2



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(Question 4 continued)

(b) (i) State the wavelength and the period of the sound wave. [2]

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(ii) Calculate the speed of the sound wave. [1]

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Turn over

(Question 4 continued)

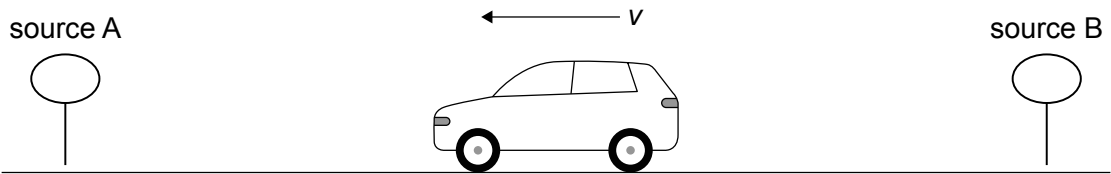
The Doppler effect applies to both sound and light waves.

- (c)
 (i)
 Explain the Doppler effect.
 [2]

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- (ii)
 A car is moving at constant velocity v between two sources of sound as shown in the diagram. The sources emit sound at 440 Hz and at 540 Hz. The driver hears both sounds at the same frequency. The speed of sound is 340 m s^{-1} .

diagram not to scale



- Determine v .
 [2]

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(Question 4 continued)

- (iii) The spectrum of light received from a galaxy shows a peak at a wavelength of 659.0 nm. The peak corresponds to an atomic transition in the hydrogen atom that emits a wavelength of 656.1 nm when observed in a laboratory on Earth.

Calculate the velocity of the galaxy with respect to Earth. [2]

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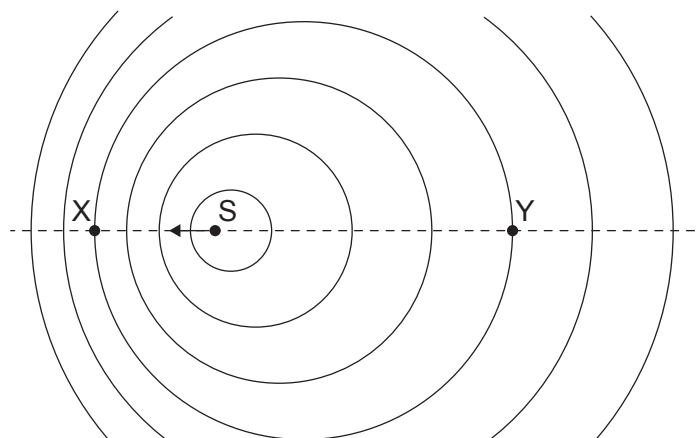
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 Answers written on this page
 will not be marked.



- 23.** A source S of a sound wave is moving at a constant velocity along a line joining stationary observers X and Y. The diagram shows consecutive wavefronts of the sound.



Consider the following statements:

- I. More wavefronts pass X in a unit time than Y.
- II. The speed of the wavefronts is greater at X than at Y.
- III. The wavelength of the sound at X is less than the wavelength at Y.

Which statements are correct?

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

- 25.** A source moving with speed v away from a stationary observer emits light of wavelength λ . The wavelength received by the observer is $\lambda + \Delta\lambda$. The speed v is much less than the speed of light.

Which graph gives the variation of $\Delta\lambda$ with v ?

