Edexcel Physics IAL

Core Practical 4: Determine the Speed of Sound in Air

Practical Notes

Core Practical 4: Determine the Speed of Sound in Air Using a 2-Beam Oscilloscope, Signal Generator, Speaker and Microphone

Equipment

- Oscilloscope
- Leads
- Microphone
- Loudspeaker
- Musical Instrument

Method

1. Connect the microphone to the oscilloscope input and play a note on the musical instrument into the microphone.
2. Use the oscilloscope to determine both the frequency and amplitude of the signal (see how to do this below).
3. To calculate the speed of the sound wave, multiply the frequency and the wavelength of the wave ($v=f\lambda$).

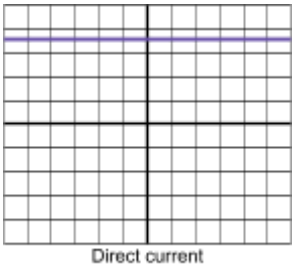
Notes

- The speed of sound in air is roughly 343 ms^{-1}.
- Experiment with different notes (different frequencies) and see how the values for the speed of sound compare.

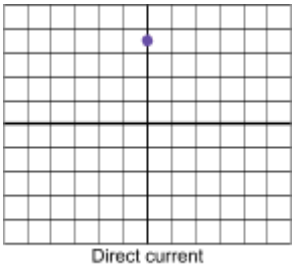
How to Read an Oscilloscope

Oscilloscopes show the variation of voltage with time, however it is possible to turn off the **time-base**, which will cause the trace to **show all the possible voltages at any time in one area**, this is useful for taking measurements. For a **direct current**, the trace will show a straight line parallel to the axis, at the height of the output voltage. If the time-base is turned off, then only a dot will be seen on the screen, at the height of the output voltage.

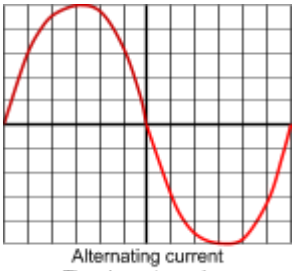
For an **alternating current**, the trace will show a repeating sinusoidal waveform which shows the variation of output voltage with time. If the time-base is switched off, then a straight vertical line will appear on the screen, showing all the possible voltages.



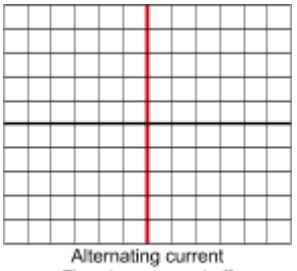
Direct current
Time base turned on



Direct current
Time base turned off



Alternating current
Time base turned on



Alternating current
Time base turned off

An oscilloscope will have a fixed grid on its display, you can adjust the scale of both axes to make measurements easier. To change the scale of the Y-axis, select the number of volts per division using a **Y-gain control dial** which will be marked on the oscilloscope. To change the scale of the X-axis, adjust the time **base**.

In order to take measurements from an oscilloscope count the number of divisions (adjusting the axes to make this easier), and multiply them by either the volts per division or the time base, depending on what you are measuring:

1. **Time period (T)** - distance from one point on a curve e.g its peak, to the point where the curve repeats, in this example when it reaches the next peak. You can find the frequency of the waveform by using the formula: $f = \frac{1}{T}$.
2. **Amplitude** - distance from the equilibrium to the highest (or lowest) point.