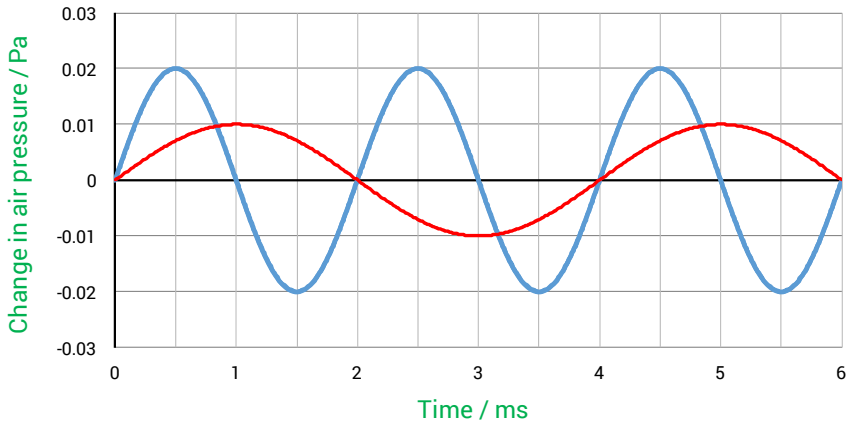
0 1

A sound engineer is preparing for a rock concert. They are investigating the sound produced by a particular speaker. The below graph shows how the change in air pressure produced by the speaker varies with time.



0 1 . 1

State the **amplitude** of the sound produced.

Amplitude = **0.02** Pa

[1 mark]

0 1 . 2

Calculate the **frequency** of the sound produced.

Include an appropriate unit with your answer.

Time period, T = 2 ms = 0.002 s (time for one full oscillation/wave/cycle)
f = 1 ÷ T = 1 ÷ 0.002 = **500 Hz**

0 1 . 3

The sound engineer then changes the uses the same equipment to produce a sound which has **half the frequency** and **half the amplitude** of the original sound.

Sketch the graph which would be obtained for this new sound wave on the above axes.

Red line above.

Maximum/minimum y-values of +0.01 and –0.01 Pa [1].
Time period of 4 ms (so half the number of waves passing a given point per second) [1].

0 2

Imelda is relaxing on the beach. She starts counting as soon as a particular wave crest reaches the shore, and notices that twelve more wave crests reach the shore in two minutes.

0 2 . 1

Show that the waves are striking the shore at a frequency of 0.1 Hz.

Number of waves = 12
Total time = 2 minutes = 120 seconds
Time period, T = total time ÷ number of waves = 120 ÷ 12 = 10 s
f = 1 ÷ T = 1 ÷ 10 = **0.1 Hz**

0 2 . 2

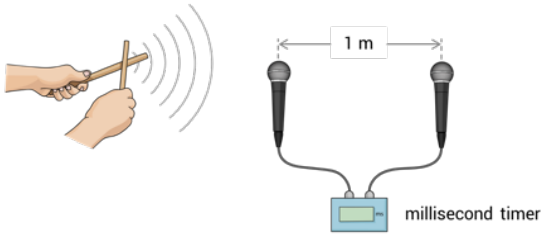
A pilot in a light plane which is flying overhead estimates that the distance between the wave crests which are striking the shore is approximately 40 m.

Use this information to estimate the speed at which the waves are striking the shore.

Wavelength, λ = 40 m
Frequency, f = 0.1 Hz
Speed, v = f λ = 0.1 × 40 = **4 m/s**

0 3

A student is using the below setup to measure the speed of sound.



The millisecond timer measures how long it takes for the sound they produce to travel from the first microphone to the second.

They obtain the following times: **3.0 ms, 2.9 ms, 3.1 ms**.

0 3 . 1

State the name given to the type of error which is present in these measurements.

Random error [1]

0 3 . 2

Use the above information to calculate an **accurate** value for the speed of sound in air.

Average time (for greatest accuracy) = (3.0 + 2.9 + 3.1) ÷ 3 = 3.0 ms
Time, t = 3.0 ms = 0.003 s
v = s ÷ t = 1 ÷ 0.003 = **333 m/s** (to nearest whole number)