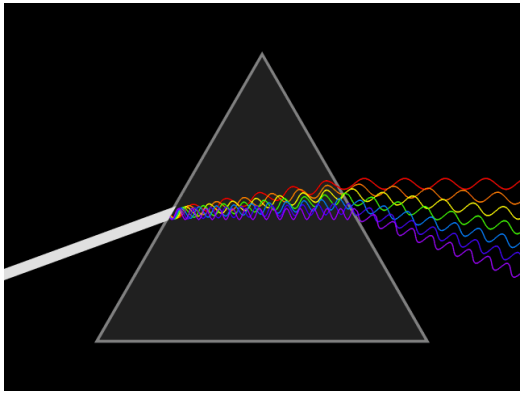
C.2

Wave Properties

IB PHYSICS | WAVE RESONANCE

What is a Wave?

C.2



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What is a Wave?

A wave is a disturbance that carries _energy_ through matter or space

matter through which a wave travels → medium

Is the Medium Moving?

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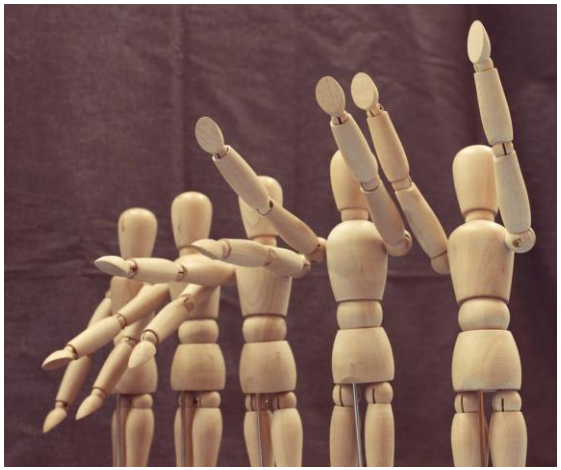
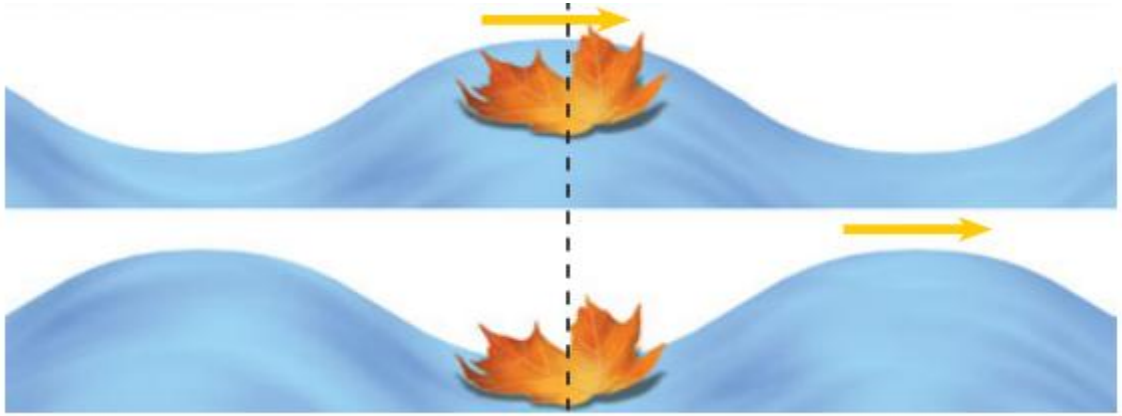
The medium particles oscillate back and forth





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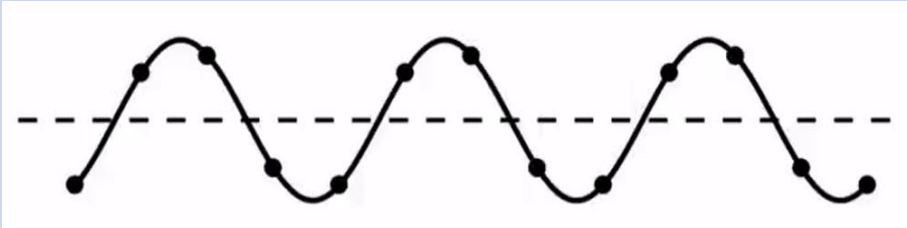
Two Types of Waves

Transverse

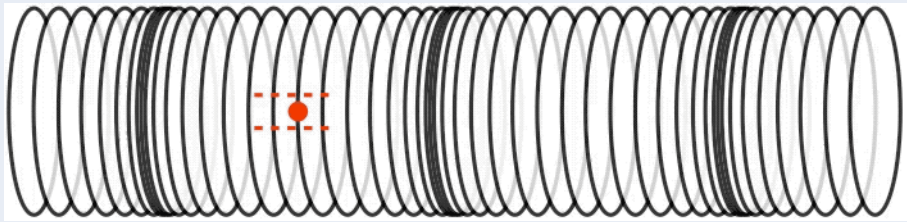
Particles move **perpendicular** to the wave's motion



Examples:
- Ripples in a pond
- Light Waves

Longitudinal

Particles move **parallel** to the wave's motion



Examples:
- Sound Waves
- Earthquake Waves

Properties of a Wave

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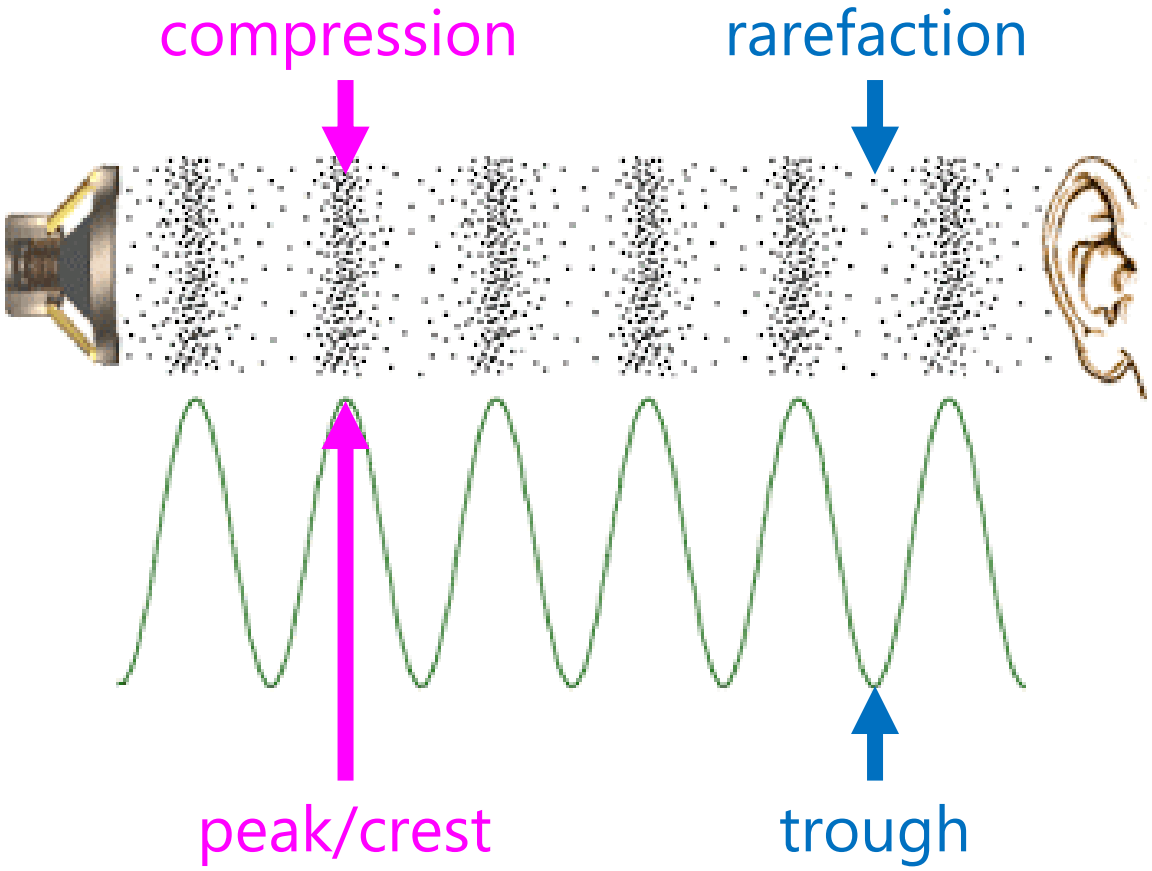
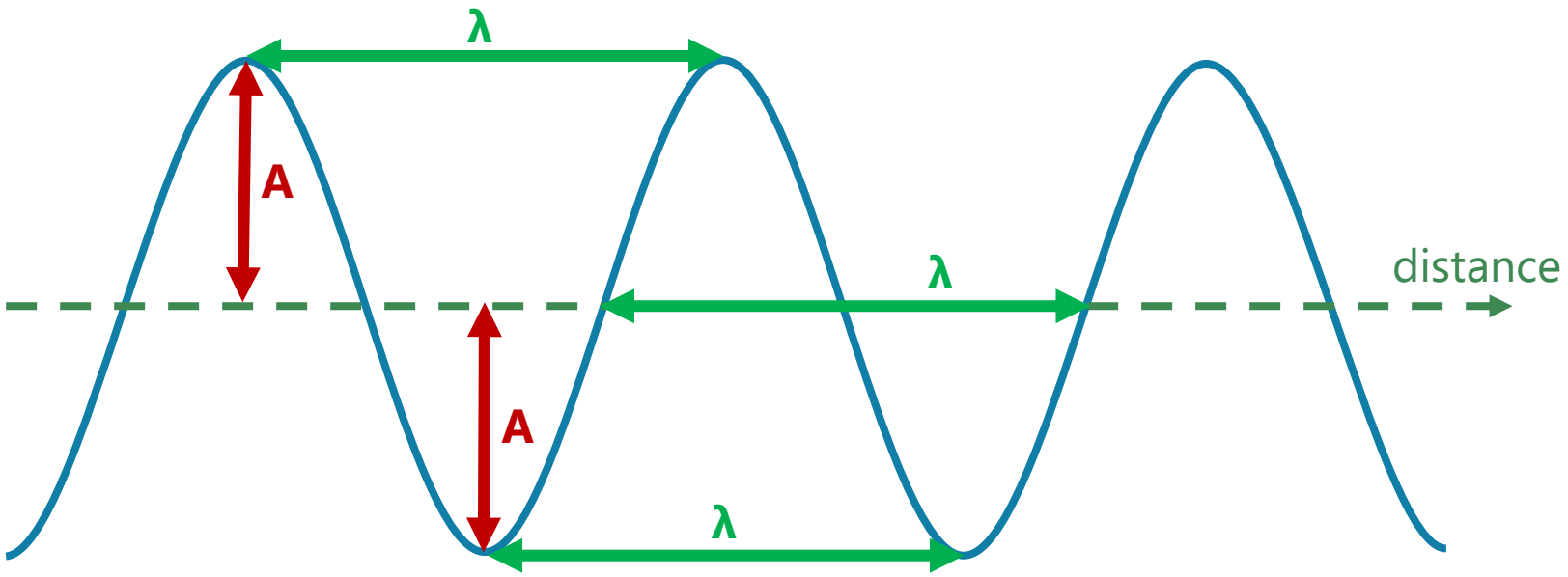


Properties of a Wave



Property	Symbol	Unit
Amplitude	**A**	**[m]**
Wavelength	**λ**	**[m]**

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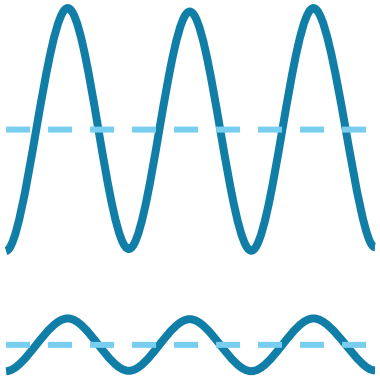
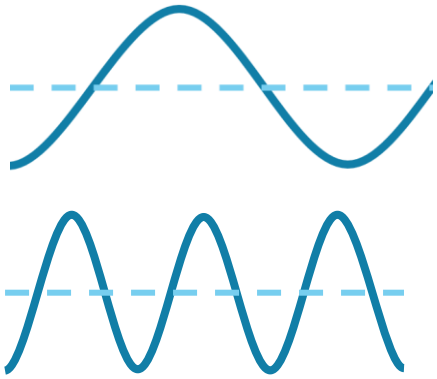
Waves and Energy



↑ Amplitude = ↑ Energy

↓ Amplitude = ↓ Energy

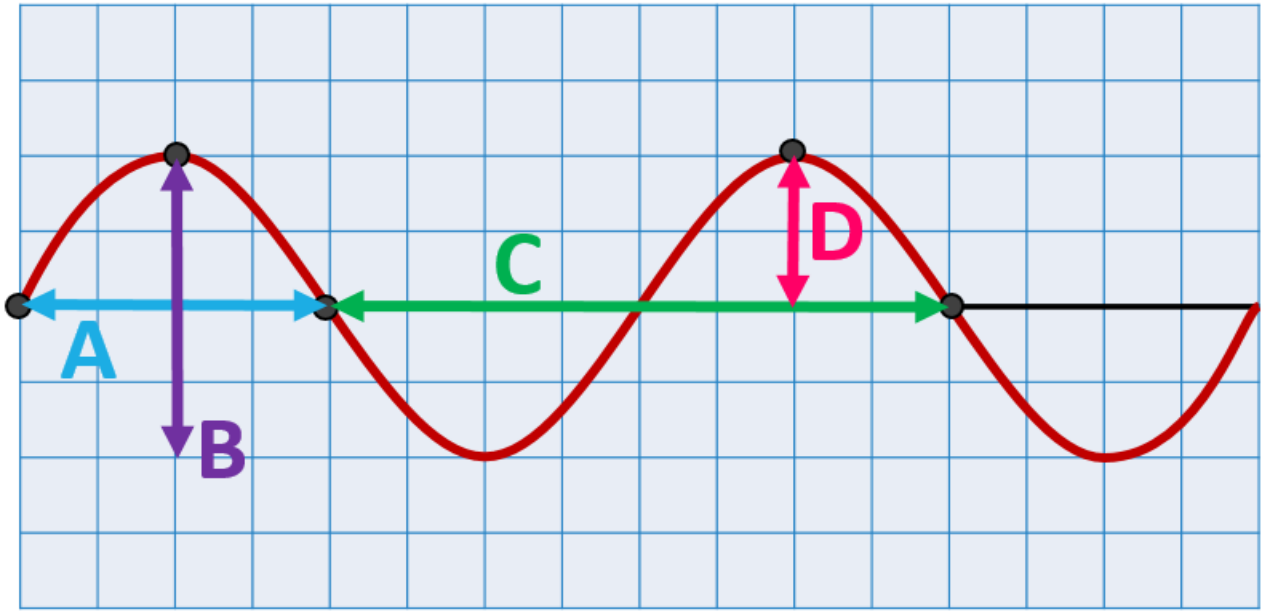


↑ Wavelength = ↓ Energy

↓ Wavelength = ↑ Energy

Label this wave

Can you identify the wave properties from this diagram?



Amplitude? **D**

Wavelength? **C**

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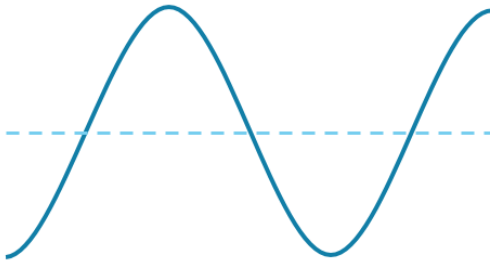
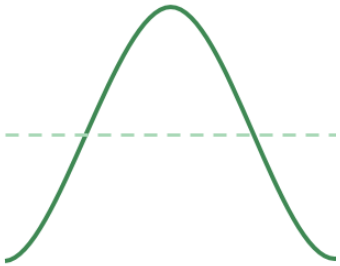
How Many Wavelengths?

1.5



1



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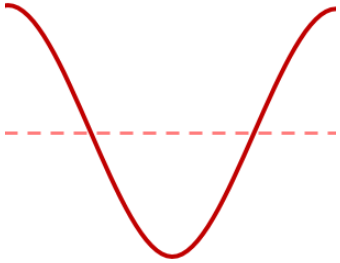
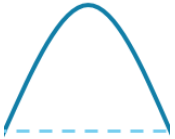
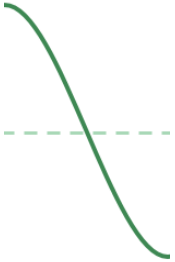


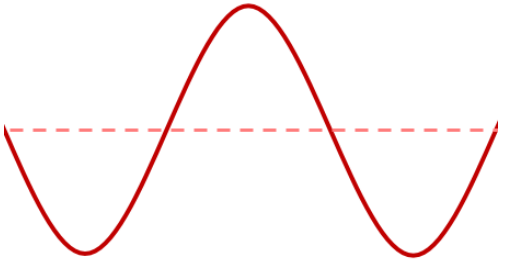
0.5



0.5



1.5



Review: What is Frequency?

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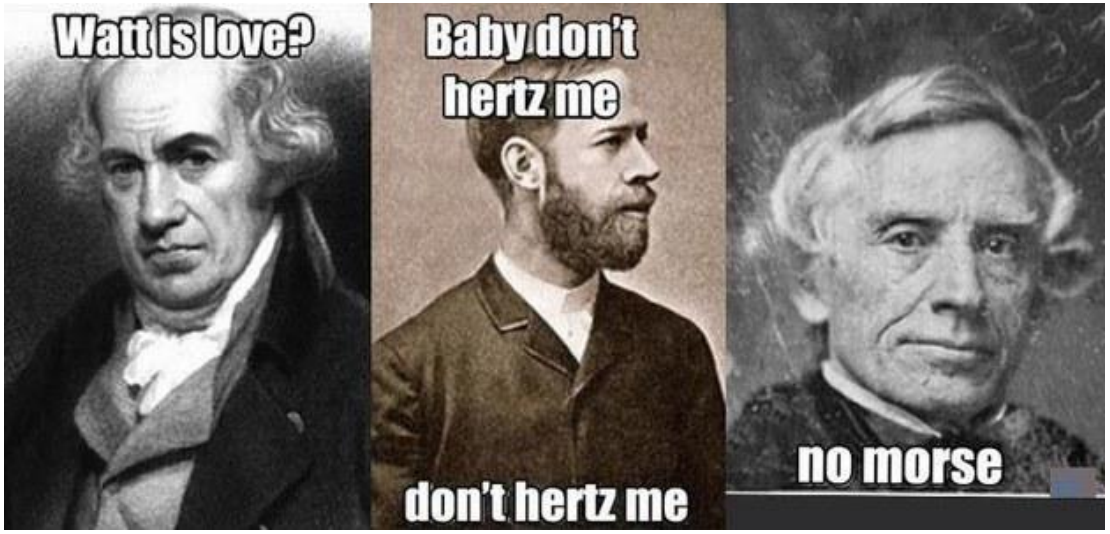
Property	What is it?	Symbol	Unit
Frequency	Cycles per second	f	[Hz]



Wavelength is related to frequency

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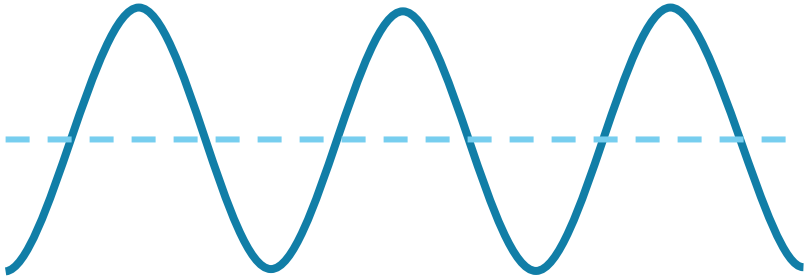
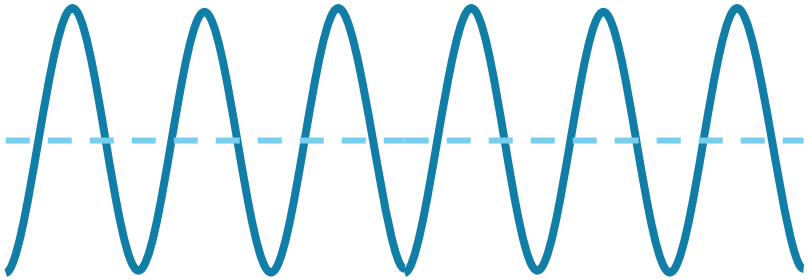


Longer wavelength

Lower frequency



Shorter wavelength

Higher frequency

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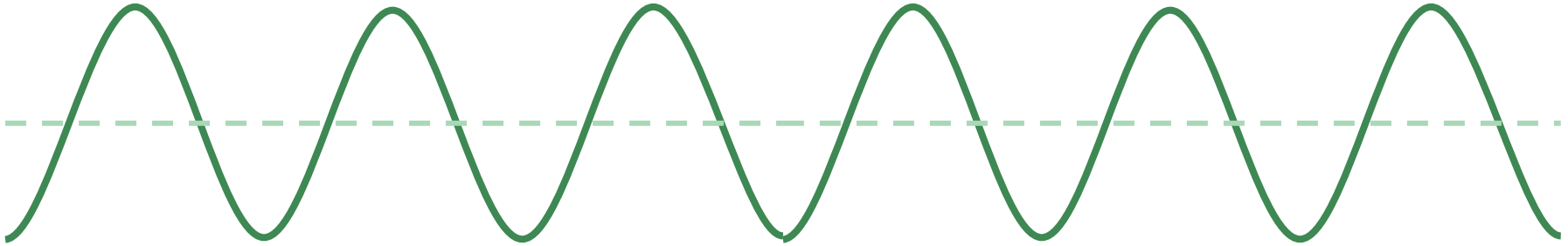
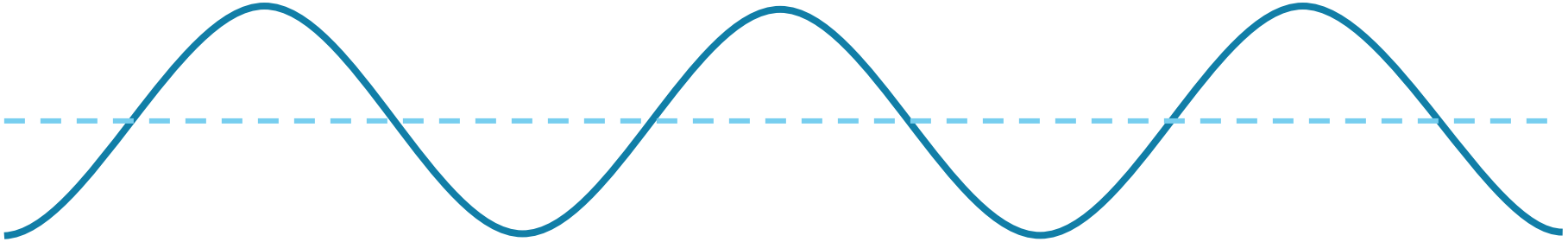
Pitch is Related to Frequency

High pitched sounds have **high** frequencies



Low pitched sounds have **low** frequencies



Sensing Pitch

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Sadly, the range of frequencies that we can hear diminishes with age…

Frequency
8,000 Hz
10,000 Hz
12,000 Hz
14,000 Hz
16,000 Hz
18,000 Hz
20,000 Hz

Wave Speed Equation

Speed = Frequency × Wavelength

Symbols

$$v = f \times \lambda$$

Units

$$[m\ s^{-1}] = [Hz] \times [m]$$

$$[s^{-1}]$$

IB Physics Data Booklet

C.2

C.1 Simple harmonic motion	$a = -\omega^2 x$ $T = \frac{1}{f} = \frac{2\pi}{\omega}$ $T = 2\pi\sqrt{\frac{m}{k}}$ $T = 2\pi\sqrt{\frac{l}{g}}$
C.2 Wave model	$v = f\lambda = \frac{\lambda}{T}$

Try this…

A piano string vibrates with a frequency of 262 Hz. If these sound waves have a wavelength in the air of 1.30 m, what is the speed of sound?

$f = 262\ Hz$

$\lambda = 1.30\ m$

$v = ??$

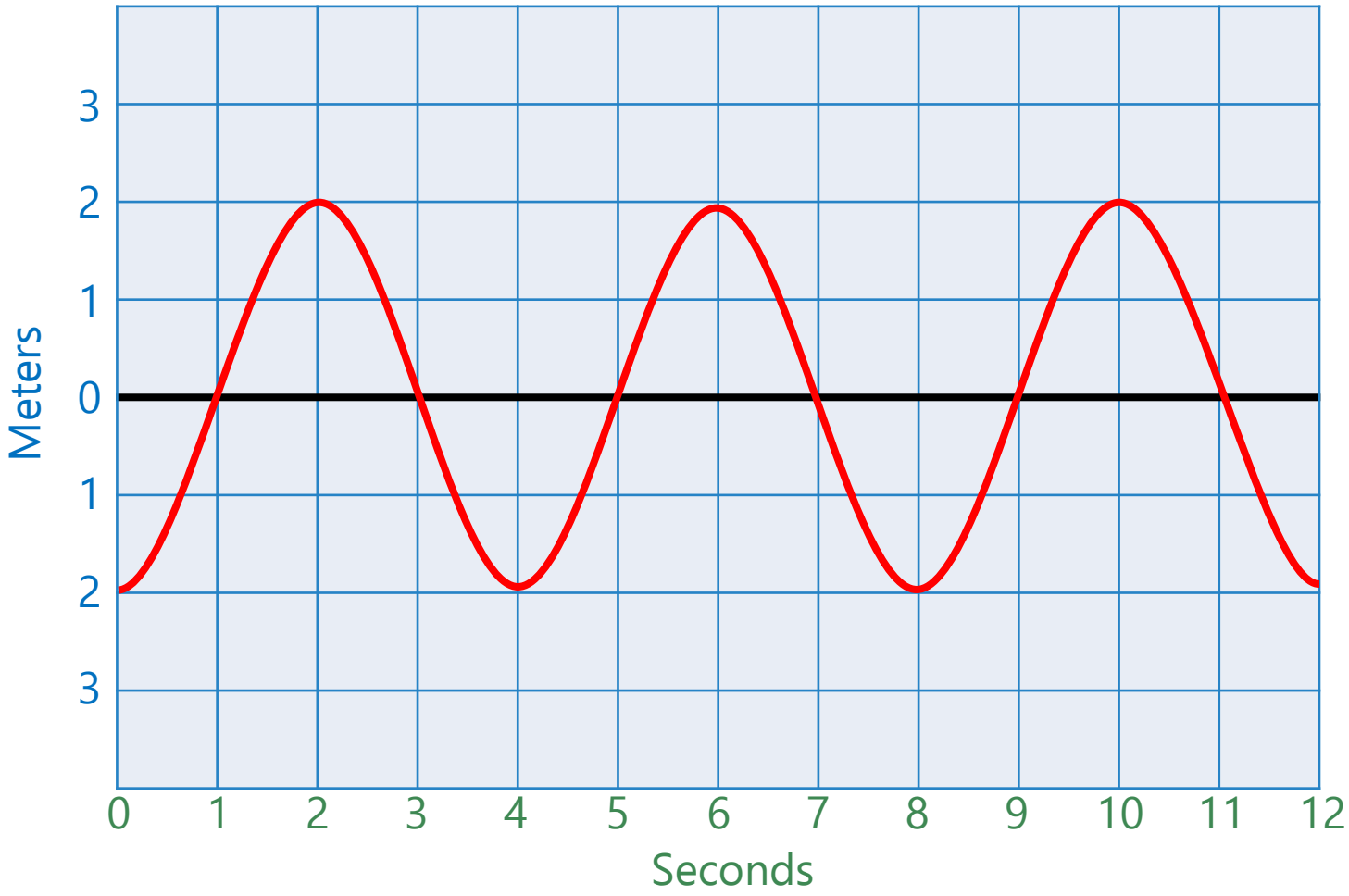
$$v = f\lambda = (262)(1.30) = 340.6\ m/s$$

$f = \frac{1}{T}$

Read a Wave #1

$T = \frac{1}{f}$

C.2



Wavelenths

3

Period

4 s

Amplitude

2 m

Frequency

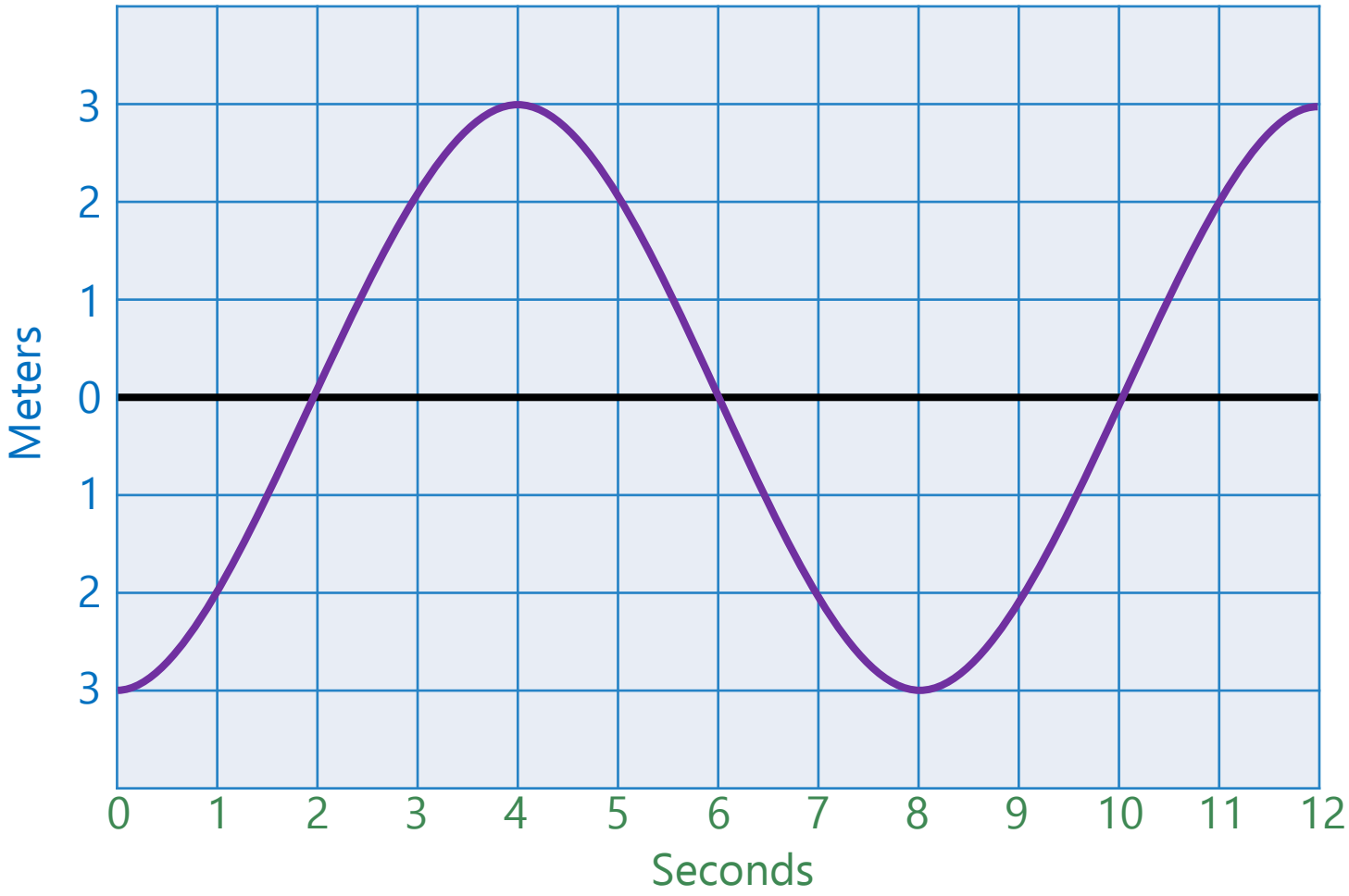
0.25 Hz

$f = \frac{1}{T}$

Read a Wave #2

$T = \frac{1}{f}$

C.2



Wavelenths

1.5

Period

8 s

Amplitude

3 m

Frequency

0.125 Hz

One Final Question…

The crests of waves passing into a harbor are 2.1 m apart and have an amplitude of 60 cm. 12 waves pass an observer every minute.

What is their frequency?

$$\frac{12\ waves}{1\ \cancel{min}} \times \frac{1\ \cancel{min}}{60\ s} = 0.2\ \frac{waves}{s}$$

$$f = \mathbf{0.2\ Hz}$$

What is their speed?

$$v = f\lambda$$

$$= (0.2)(2.1)$$

$$= \mathbf{0.42\ m\ s^{-1}}$$

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Lesson Takeaways

- ❑ I can describe how waves carry energy through a medium
- ❑ I can compare the properties of transverse and longitudinal waves
- ❑ I can read a wave's amplitude, wavelength, period, and frequency from a graph
- ❑ I can describe the number of complete wavelengths represented in a picture
- ❑ I can use the wave speed equation to mathematically relate speed, wavelength, and frequency