Physics 20

Unit D: Oscillations and mechanical waves

Properties of mechanical waves

A ribbon stays while the pulse leaves

- A coloured ribbon is taped to one loop of a long coil stretched 6.0 m across the gym floor.
- A sharp push sends a compression 6.0 m in 2.40 s, and the ribbon jitters beside its tape mark.

Names for a travelling disturbance

- A mechanical wave keeps each particle oscillating near its start while energy moves forward.
- If the coil moves sideways while the pulse runs forward, the wave is transverse. If the coil pushes along the pulse, the wave is longitudinal.
- On that travelling shake you measure wavelength, wave speed, period, frequency, amplitude, the wave front, and the ray.

Key terms

mechanical wave

A mechanical wave is a disturbance in which particles of a medium oscillate in simple harmonic motion while energy travels forward.

transverse wave

A transverse wave moves particles of the medium perpendicular to the direction of propagation.

longitudinal wave

A longitudinal wave moves particles of the medium along the direction of propagation.

wavelength

Wavelength is the distance from one crest to the neighbouring crest, measured along the direction of travel. (lambda)

Key terms

wave speed

Wave speed is the speed at which the disturbance travels through the medium. (v)

wave front

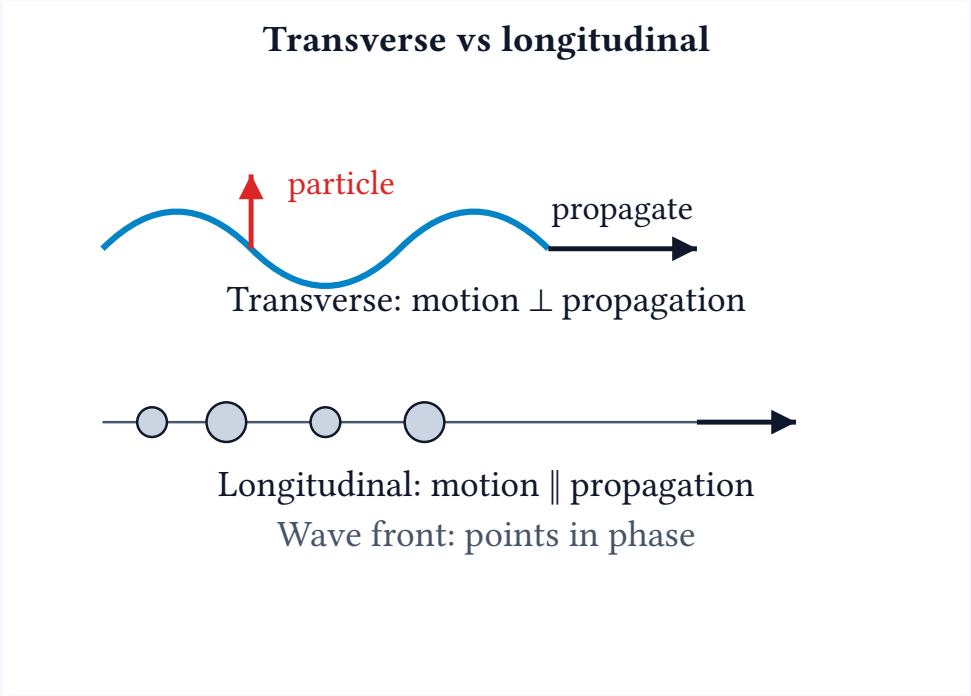
A wave front is a line or surface joining points of the medium that move together at the same stage of the cycle.

ray

A ray is an arrow drawn perpendicular to a wave front, showing the direction of energy travel.

Sideways shakes and lengthwise pushes

- In a transverse wave the particle motion is perpendicular to the direction of propagation.
- In a longitudinal wave the particle motion is along the direction of propagation.
- A wave front is a line through points that are moving together.
- A ray leaves that line at a right angle and shows where the wave is going.



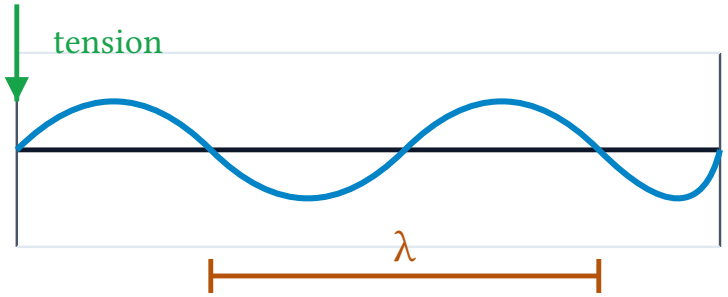
A 686 Hz whistle in warm air

- A whistle of frequency 686 Hz sounds in air at 20 degrees Celsius, where the wave speed is 343 m/s.
- Wavelength = 343 m/s / 686 Hz = 0.500 m.
- Sound in air is a longitudinal wave, so the air particles move along the ray.

The medium sets the wave speed

- Wave speed on a string depends on the tension and the linear density of that string.
- Wave speed of sound in air depends on the temperature of the air.
- With one variable changed and another held constant, v = f lambda predicts the new wavelength.

Wave speed on a medium



$$v = f\lambda$$

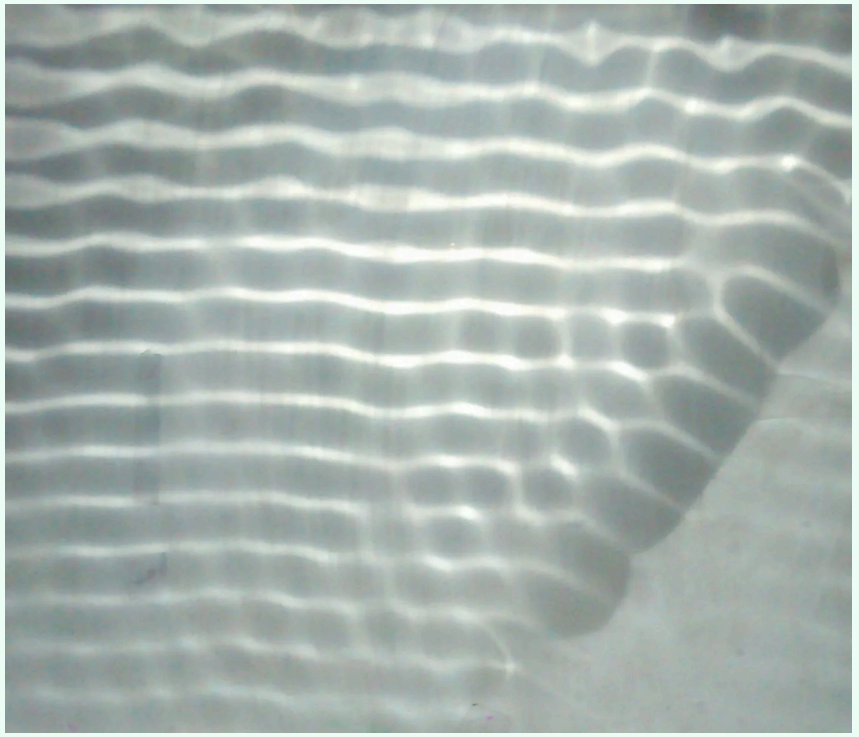
String: v set by tension & density

Sound: v set by air temperature

Hold one variable fixed to predict λ

A ripple tank held at one speed

- A ripple tank shows crests 0.125 m apart, and 4.00 crests pass a dot each second.
- Find the wave speed, then predict the wavelength if the paddle slows to 2.00 Hz in the same water.
- Verify the prediction with v = f lambda.



Harbour crests

- Harbour crests are 2.40 m apart, and a crest passes a piling every 4.00 s.
- Find the wave speed.
- Predict the new wavelength if crests pass every 2.00 s and the harbour water is unchanged.

Image credits

Psgs123xyz (talk) (Uploads)., Reflection of waves observed using a ripple tank., CC0 1.0