Chapter 14. Properties of waves

Contents:

New word list:

Crest trough peak valley amplitude frequency wavelength
Transverse longitudinal
Reflection refraction diffraction
Ripple ripple bank dipper

3.1 General properties of waves

Core

1 Know that waves transfer energy without transferring matter

2 Describe what is meant by wave motion as illustrated by vibrations in ropes and springs, and by experiments using water waves

3 Describe the features of a wave in terms of wavefront, wavelength, frequency, crest (peak), trough, amplitude and wave speed

4 Recall and use the equation for wave speed

$v = f\lambda$

5 Know that for a transverse wave, the direction of vibration is at right angles to the direction of propagation and understand that electromagnetic radiation, water waves and seismic S-waves (secondary) can be modelled as transverse

Supplement

continued

Core

6 Know that for a longitudinal wave, the direction of vibration is parallel to the direction of propagation and understand that sound waves and seismic P-waves (primary) can be modelled as longitudinal

7 Describe how waves can undergo:
(a) reflection at a plane surface
(b) refraction due to a change of speed
(c) diffraction through a narrow gap

8 Describe the use of a ripple tank to show:
(a) reflection at a plane surface
(b) refraction due to a change in speed caused by a change in depth
(c) diffraction due to a gap
(d) diffraction due to an edge

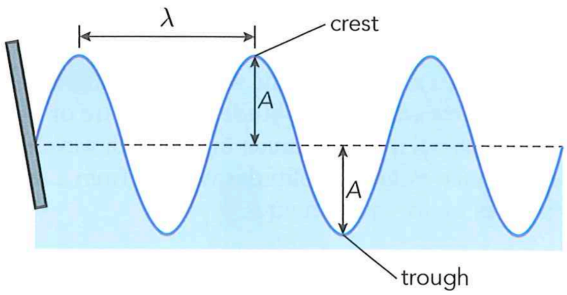
Supplement

9 Describe how wavelength and gap size affects diffraction through a gap

10 Describe how wavelength affects diffraction at an edge

14.1 Wave motion

What are waves?



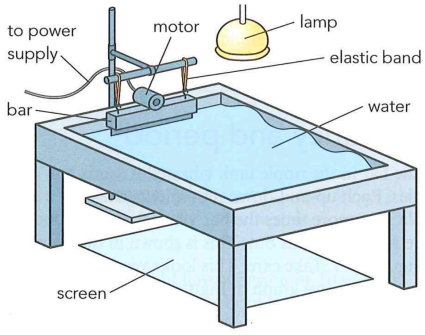
Wave in physics is a **model**:

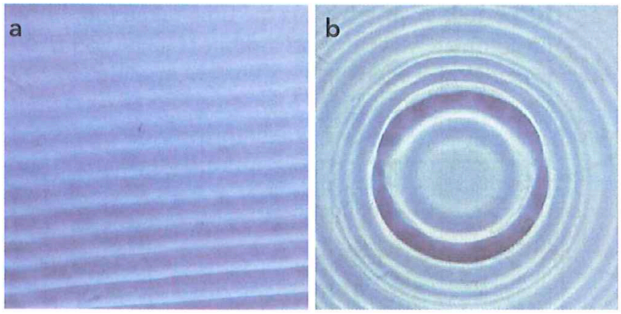
In physics, we extend the **idea of a wave** to describe many other phenomena, including **light, sound**, etc. We do this by imagining an **idealized** wave.

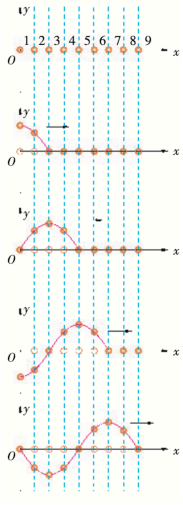
Making waves:

1. rope

2.ripple tank







From the demonstrations we watched, can you explain how do waves form?

Molecule moves up and down and drags its neighbors up and down

In rope and ripple tank experiments, Bar/dipper/hand vibrates up and down **vertically about a fixed point** => ripplers move out **horizontally**

Wave transfers energy not matter/wave is moving not matter

How do we describe waves in physics? What physical quantities do we use?

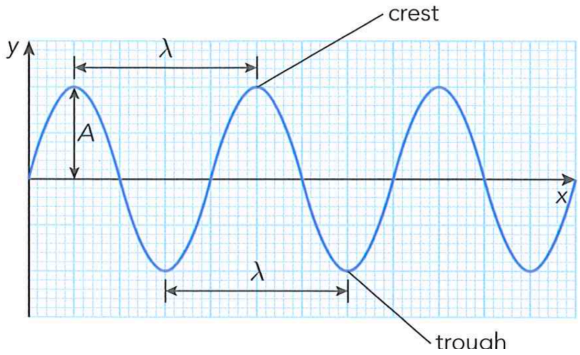
14.2 Features of a wave (Wave model)

1. Displacement-distance graph(波形图)

Wavelength λ: the distance from one **crest** to the next/ btw any two points which are in step; unit: m

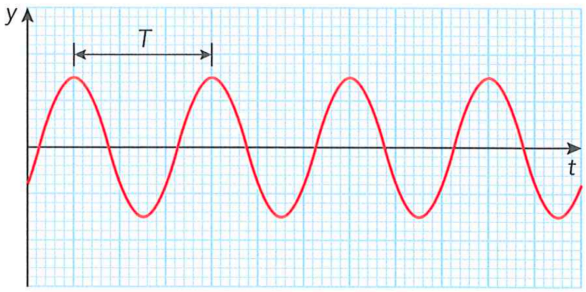
Amplitude A: the height of the crest/the depth of a trough; unit: m

Wavefront: the set of all points having the same *phase*/moving for the same time -> e.g. **all crests**



Wave at a particular time moves up and downs at different **positions**

2. displacement- time graph（振动图）



Wave at **a particular point** moves up and down as time

Frequency f: number of waves send out per second; unit: Hz

Period T: the time taken for one complete wave to pass a point; $T = \frac{1}{f}$

14.3 Speed, frequency and wavelength

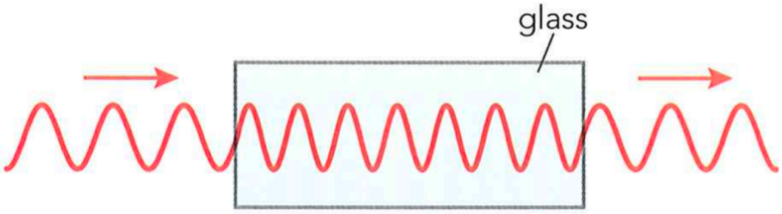
Wave speed: the rate at which the crest of a wave travels

E.g. the speed of the crest of a ripple traveling over the surface of the water

Unit: m/s

Equations:

Sound wave through air: $v = 330 m/s$

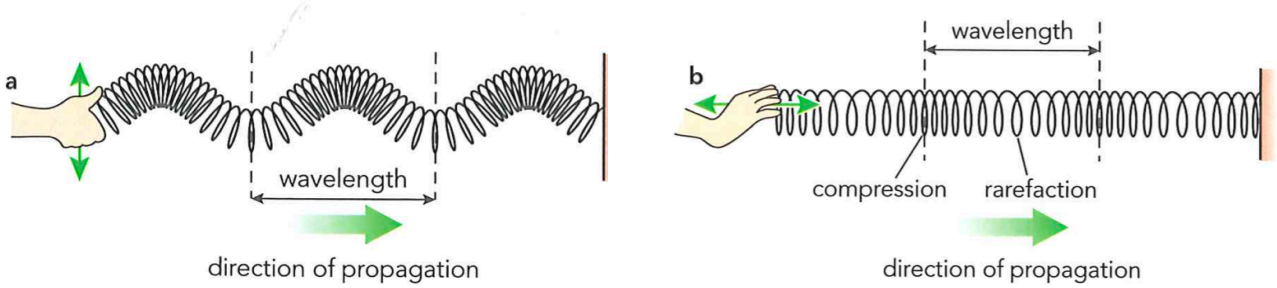


Light wave through air:

$v \approx 3 \times 10^8 m/s$

Waves travel in different materials will have different speed.

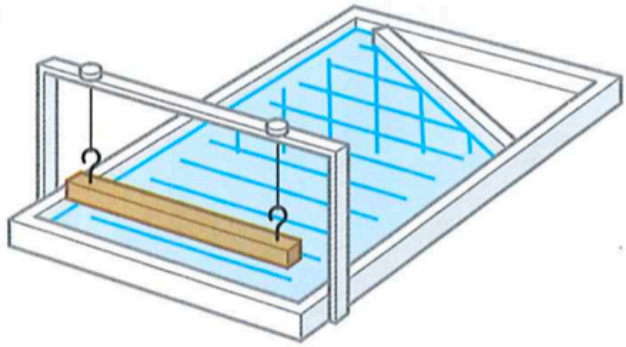
When waves travel from a medium to another one



Transverse and longitudinal waves

Transverse waves	Longitudinal waves
ripples on water	sound
light and all other electromagnetic waves	primary seismic waves (P-waves)
secondary seismic waves (S-waves)	

b



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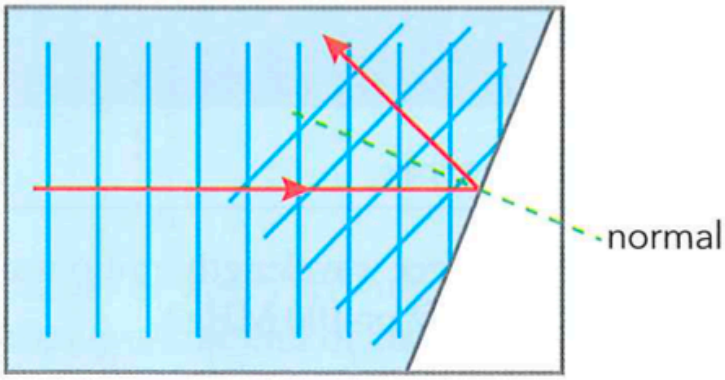
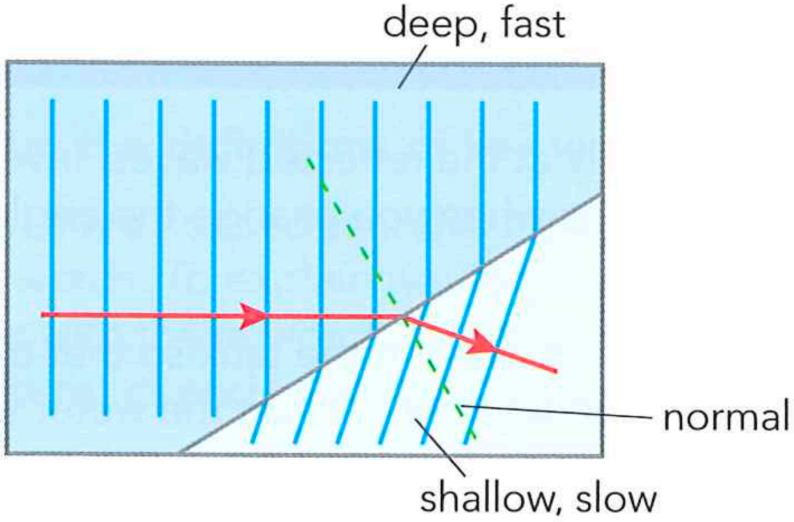
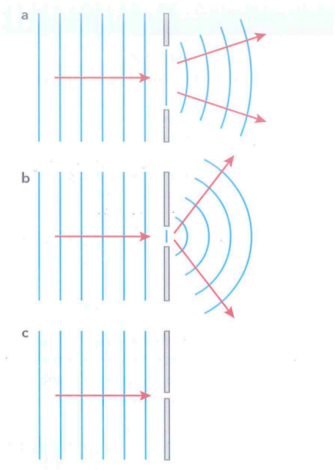


Refraction:

b



Diffraction: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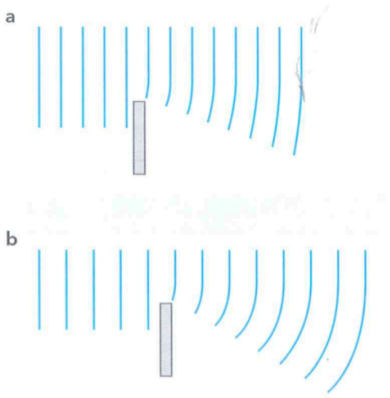
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