

8.2 Diffraction

Name: _____ Class: _____ Date: _____

Total: 23 marks

KEY WORDS diffraction 衍射 • wavelength 波长 • obstacle 障碍物 • wave 波

Objective

Build the skills to answer exam questions on **diffraction** 衍射 — what it is and how it depends on the gap width.

You must be able to:

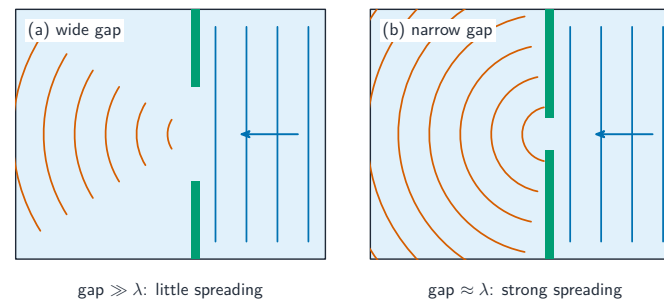
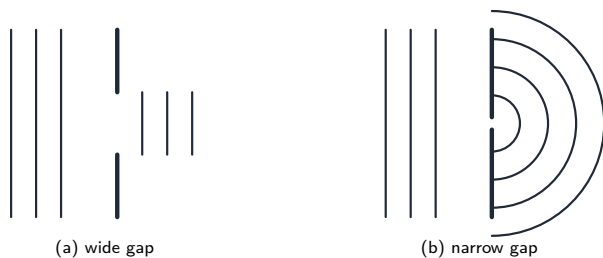
- explain **diffraction** and where it occurs
- describe how the **gap width** relative to the **wavelength** changes the spreading

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ Diffraction

Diffraction is the **spreading** of a wave as it passes through a gap or around an obstacle. **All** waves diffract. The spreading depends on the **gap width compared with the wavelength**:

gap $\gg \lambda$: little spreadinggap $\approx \lambda$: strong spreading

Diffraction of waves through a gap

- gap **much wider** than $\lambda \rightarrow$ little spreading;
- gap **about** $\lambda \rightarrow$ strong spreading.

This is why you can **hear** around a corner (sound $\lambda \approx 1$ m, near a doorway's width) but cannot **see** around it (light $\lambda \approx 500$ nm, far smaller). The wavelength and speed are **unchanged** by diffraction.

2 Practice

Now apply the methods above.

2.1 Define **diffraction**. [1]

2.2 State what happens to the amount of diffraction as a gap is made **narrower** (towards the size of λ). [1]

2.3 State why you can **hear** but not **see** around a corner. [2]

2.4 State which kinds of wave can **diffract**. [1]

3 Exam-style questions

3.1 Noticeable diffraction occurs when the gap width is: [1]

- | | |
|---|---|
| A | B |
| C | D |
- A much larger than the wavelength
B about the same as the wavelength
C exactly zero
D a thousand times the wavelength

3.2 Explain, using diffraction, why **sound** passes through a doorway and spreads into the room, but **light** does not noticeably spread. [3]

3.3 Describe a **ripple-tank** experiment to show that diffraction depends on the gap width. [3]

3.4 State the effect of diffraction on the **wavelength** and **speed** of the wave. [1]

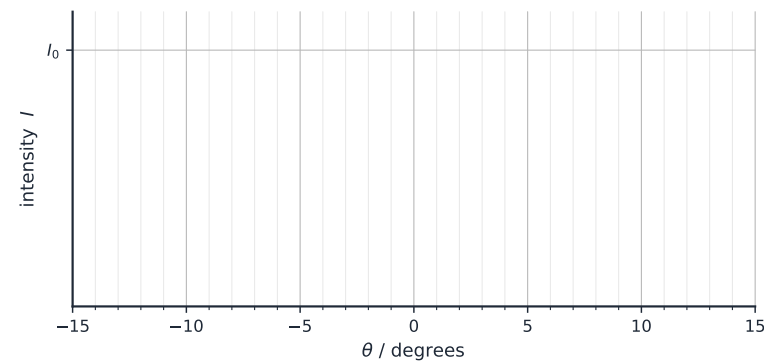
3.5 A parallel beam of light of wavelength 540 nm falls normally on a diffraction grating whose lines are 5.0×10^{-6} m apart. The grating sits at the centre of a circular screen, and the central bright fringe forms at $\theta = 0$ with intensity I_0 .

(a) **State** what is meant by the **diffraction** of a wave. [2]

(b) **Show that** the first-order bright fringe forms at $\theta = 6.2^\circ$. [2]

(c) **Determine** the angle at which the **second-order** fringe forms. [1]

(d) On the axes below, **sketch** how the intensity I varies with θ between -15° and $+15^\circ$. [3]



(e) A polarising filter is now placed in the beam **before** the grating. **Suggest** how the pattern on the screen changes. [2]
