

Exercise walk-through

14.7

Diffraction

AP Physics 2

Diffraction and the double slit

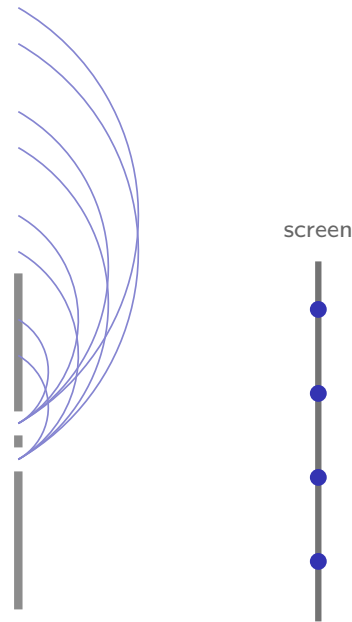
Diffraction : waves spread through gaps and around obstacles – most when the gap $\approx \lambda$.

Young's double slit – bright fringes

$$d \sin \theta = m\lambda$$

A **grating** (many slits) sharpens them into thin lines.

Thin-film interference
colours soap bubbles and oil slicks.



Intensity, and the antireflection coating

intensity

the average power a wave delivers **per unit area** over one period, in W/m^2

through a polarizer

unpolarised light loses **half**; after that, $I = I_0 \cos^2 \theta$

a thin film

light reflecting off its top and bottom surfaces interferes with itself

what decides the colour

the film's thickness and the wavelength – which is why a soap bubble's colours shift as it thins

an antireflection coating

the same physics used deliberately, on camera lenses, glasses and solar cells

how it works

a layer of chosen thickness makes the two reflections **cancel**, so more light is transmitted

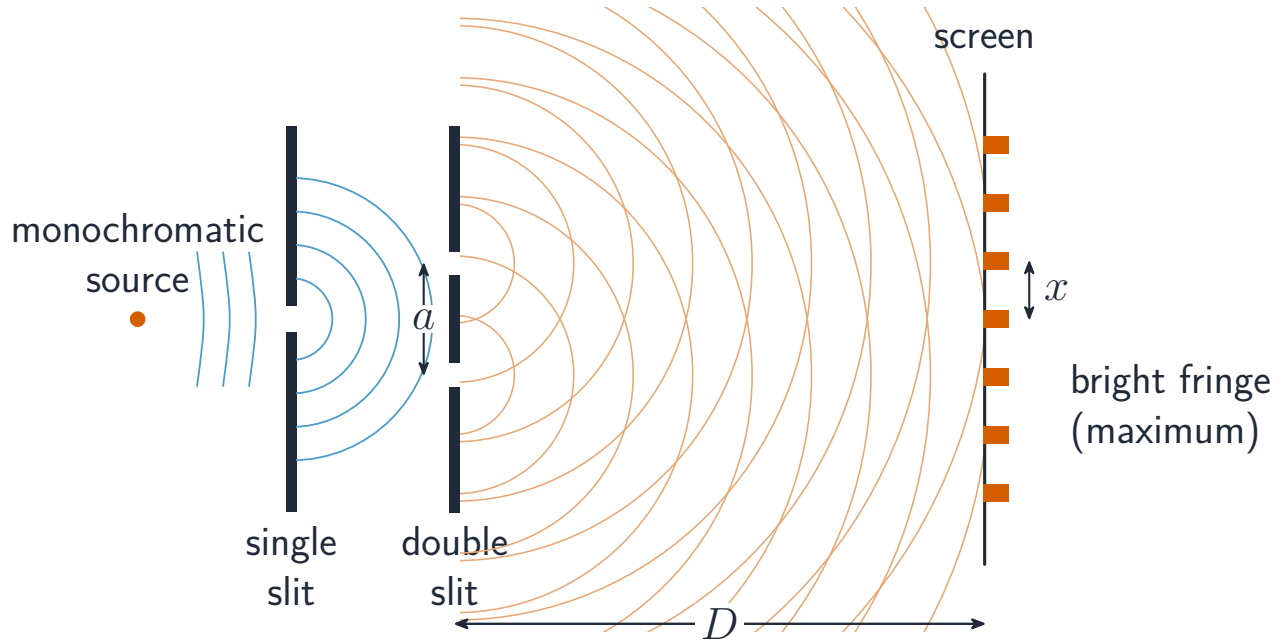
A reflection off a **denser** medium adds a half-wavelength shift. Counting that extra half turns a thin-film question from guesswork into arithmetic.

Describing a periodic wave, and how two waves add

the quantities	wavelength λ , period T , frequency $f = 1/T$, amplitude, and speed $v = f\lambda$
coherent sources	same frequency and a constant phase relationship – the condition for a stable interference pattern
constructive interference	path difference is a whole number of wavelengths; the amplitudes add
destructive interference	path difference is an odd number of half wavelengths; they cancel
beat frequency	$ f_1 - f_2 $ – the slow swell when two close frequencies overlap
what sets v	the medium , not the source – so changing f changes λ

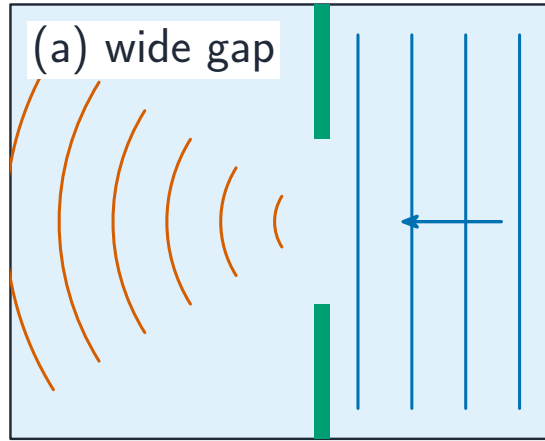
Every interference question reduces to a **path difference in wavelengths**. Work that out first and the constructive/destructive answer follows.

Double-Slit Interference and Diffraction Gratings

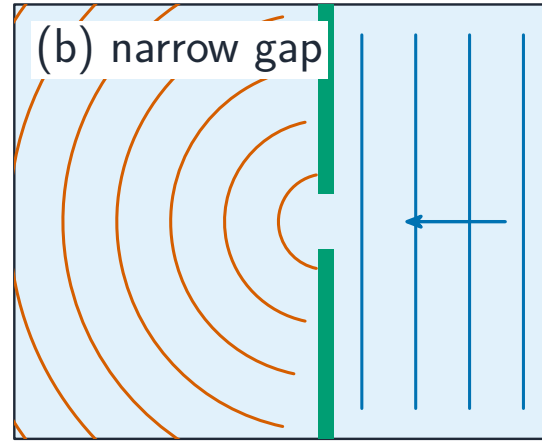


Young's double slits give an interference pattern of bright and dark fringes

Diffraction



gap $\gg \lambda$: little spreading



gap $\approx \lambda$: strong spreading

Waves spread out (diffract) as they pass through a gap

Exercises 2.1-2.3

2.1 State what diffraction is.

[1]

2.2 State when diffraction through a gap is greatest.

[1]

2.3 State what the diffraction of light shows about its nature.

[1]

Exercises 2.1-2.3

2.1 State what diffraction is.

[1]

2.1

- the spreading of waves around obstacles and through gaps
-

2.2 State when diffraction through a gap is greatest.

[1]

2.2

- when the gap is about the same size as the wavelength
-

2.3 State what the diffraction of light shows about its nature.

[1]

2.3

- that light behaves as a wave

Exercises 3.1-3.2

3.1 Diffraction is the _____ of waves around obstacles.

[1]

☐

A speeding up

B spreading

C reflection

D absorption

3.2 Diffraction through a gap is greatest when the gap size is

[1]

☐

A much larger than the wavelength

B about equal to the wavelength

C zero

D infinite

Exercises 3.1-3.2

3.1 Diffraction is the _____ of waves around obstacles.

[1]

☐

- A speeding up
- B spreading
- C reflection
- D absorption

3.1 B

- spreading.

3.2 Diffraction through a gap is greatest when the gap size is

[1]

☐

- A much larger than the wavelength
- B about equal to the wavelength
- C zero
- D infinite

3.2 B

- about equal to the wavelength.

Exercise 3.3 (a)

3.3 Water waves pass through a gap in a barrier.

(a) Describe what happens to the waves as they pass through.

[1]

Exercise 3.3 (a)

3.3 Water waves pass through a gap in a barrier.

(a) Describe what happens to the waves as they pass through.

[1]

(a)

- they spread out into the region beyond the gap

Exercise 3.3 (b)

3.3 Water waves pass through a gap in a barrier.

(b) State how to make them spread out more (for the same waves).

[2]

Exercise 3.3 (b)

3.3 Water waves pass through a gap in a barrier.

(b) State how to make them spread out more (for the same waves). [2]

(b)

- make the gap narrower (closer to the wavelength)