# Diffraction 3

## Essential GCSE Physics 44.3

Year 9 C C C

GCSE C C C

*This question has been reworded to make it clearer. It may look different to the question in your book, but it contains the same data and has the same correct answer.*

Rank the waves below from the one which will spread out the most after passing a gap to the one which will spread out the least.

*[Hint: the smaller the wavelength in comparison to the gap, the less the wave will spread out.]*

### Available items

- Wavelength $= 550\,\text{nm}$, Gap width $= 0.010\,0\,\text{mm}$
- Wavelength $= 700\,\text{nm}$, Gap width $= 0.100\,\text{mm}$
- Wavelength $= 1\,400\,\text{nm}$, Gap width $= 100\,\mu\text{m}$
- Wavelength $= 5.00\,\text{cm}$, Gap width $= 10\,\text{cm}$
- Wavelength $= 15.0\,\text{cm}$, Gap width $= 1\,000\,\mu\text{m}$

# Diffraction 4

Year 9 C C C

GCSE C C C

## Essential GCSE Physics 44.4

A young astronomer has a telescope with a $6.0\,\mathrm{cm}$ diameter lens, and uses it to take pictures using visible light (wavelength $= 500\,\mathrm{nm}$). The main factor causing blurring in a good telescope is diffraction.

If a professional astronomer wanted images just as precise using $30\,\mathrm{cm}$ radio waves, what diameter of dish would be needed?

Gameboard:

**STEM SMART Physics 11 - Interference & Diffraction**

# Interference 1

A Level

## Essential Pre-Uni Physics D4.1

Complete the questions in the table for a double slit experiment:

| Wavelength | Slit separation | Distance to screen / m | Fringe spacing / mm |
|---|---|---|---|
| 633 nm | 0.10 mm | 4.00 | (a) |
| 530 nm | (b) | 6.00 | 4.0 |
| (c) | 1.0 mm | 1.50 | 0.20 |
| 0.30 cm | 0.10 m | 2.50 | (d) |

### Part A Fringe spacing (a)

| Wavelength | Slit separation | Distance to screen / m | Fringe spacing / mm |
|---|---|---|---|
| 633 nm | 0.10 mm | 4.00 | (a) |

a) Fringe spacing in mm?

### Part B Slit separation (b)

| Wavelength | Slit separation | Distance to screen / m | Fringe spacing / mm |
|---|---|---|---|
| 530 nm | (b) | 6.00 | 4.0 |

b) Slit separation?

## Part C Wavelength (c)

| Wavelength | Slit separation | Distance to screen / $\mathrm{m}$ | Fringe spacing / $\mathrm{mm}$ |
|---|---|---|---|
| (c) | $1.0\,\mathrm{mm}$ | $1.50$ | $0.20$ |

c) Wavelength?

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## Part D Fringe spacing (d)

| Wavelength | Slit separation | Distance to screen / $\mathrm{m}$ | Fringe spacing / $\mathrm{mm}$ |
|---|---|---|---|
| $0.30\,\mathrm{cm}$ | $0.10\,\mathrm{m}$ | $2.50$ | (d) |

d) Fringe spacing in $\mathrm{mm}$?

(Note that the values given in the book were incorrect for some printings, so make sure that you are using the values given above.)

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Gameboard:

**STEM SMART Physics 11 - Interference & Diffraction**

# Interference 2

A Level

## Essential Pre-Uni Physics D4.2

Complete the questions in the table for a diffraction grating:

| Wavelength | Slit separation | Order of interference $n$ | Angle to 'straight through direction' |
|---|---|---|---|
| $633\,\text{nm}$ | $0.10\,\text{mm}$ | $2$ | (a) |
| $530\,\text{nm}$ | $600\,\text{lines/mm}$ | $1$ | (b) |
| (c) | $1000\,\text{lines/mm}$ | $1$ | $10^\circ$ |
| $1.0\times10^{-11}\text{m}$ | (d) | $3$ | $20^\circ$ |

### Part A Angle (a)

| Wavelength | Slit separation | Order of interference $n$ | Angle to 'straight through direction' |
|---|---|---|---|
| $633\,\text{nm}$ | $0.10\,\text{mm}$ | $2$ | (a) |

a) Angle to 'straight through' direction to 2 significant figures?

### Part B Angle (b)

| Wavelength | Slit separation | Order of interference $n$ | Angle to 'straight through direction' |
|---|---|---|---|
| $530\,\text{nm}$ | $600\,\text{lines/mm}$ | $1$ | (b) |

b) Angle to 'straight through' direction to 3 significant figures?

## Part C Wavelength (c)

| Wavelength | Slit separation | Order of interference $n$ | Angle to 'straight through direction' |
|---|---|---|---|
| (c) | $1000\,\text{lines}/\text{mm}$ | $1$ | $10^\circ$ |

c) Wavelength?

## Part D Slit separation (d)

| Wavelength | Slit separation | Order of interference $n$ | Angle to 'straight through direction' |
|---|---|---|---|
| $1.0 \times 10^{-11}\text{m}$ | (d) | $3$ | $20^\circ$ |

d) Slit separation in $\text{m}$?

Gameboard:

**STEM SMART Physics 11 - Interference & Diffraction**

Physics. You work it out.



# Interference 4

A Level

P P P

## Essential Pre-Uni Physics D4.4

This question has been reworded to make it clearer. It may look different to the question in your book, but it contains the same data and has the same correct answer.

A microscope slide looks like it has one fine transparent line ruled on a black background. In fact there are two lines very close together. When red light ($633\,\text{nm}$) is shone through it, and a screen is placed $5.0\,\text{m}$ away from the slide, ten fringe-spacings measure $5.3\,\text{cm}$. Calculate the separation of the lines on the slide.

Gameboard:

**STEM SMART Physics 11 - Interference & Diffraction**

# Interference 5

A Level

C C C

## Essential Pre-Uni Physics D4.5

The light from a 'special LED' consists of two colours of light with wavelengths of $530\,\text{nm}$ and $630\,\text{nm}$ respectively. The light is shone through a diffraction grating with $500\,\text{lines/mm}$, and the two colours need to be separated by at least $5.0\,^\circ$. What is the minimum order of interference needed in order to do this?

Gameboard:

**STEM SMART Physics 11 - Interference & Diffraction**

# Modified Double Slit

A Level

C C C

The diagram below illustrates an experimental arrangement that produces interference fringes with a double slit.

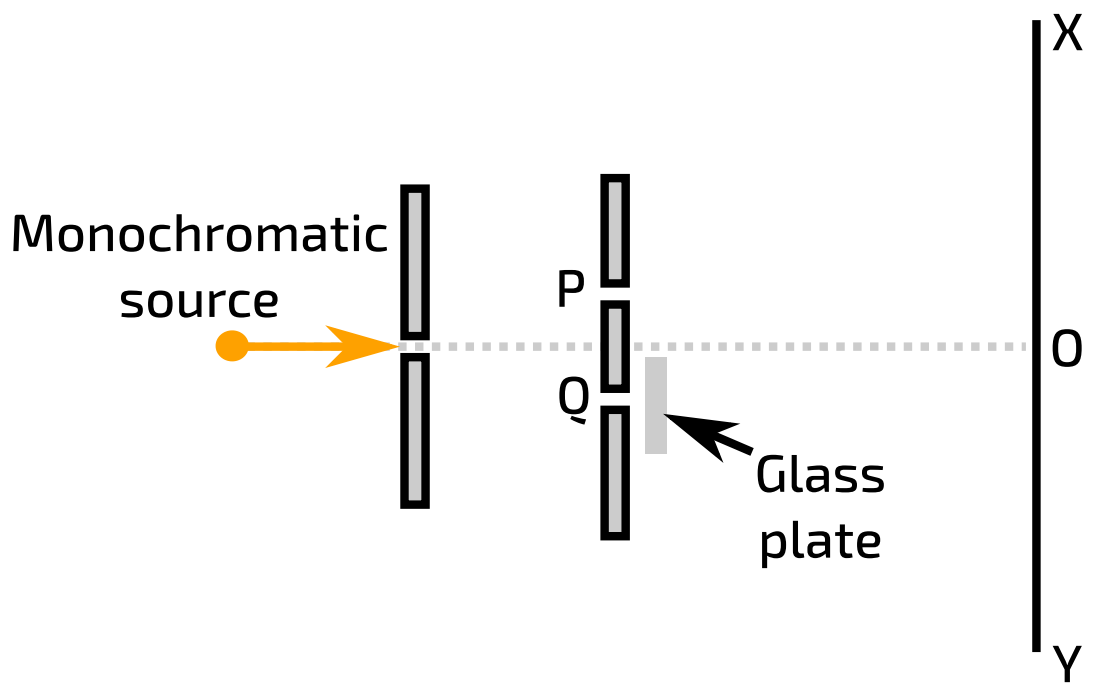


**Figure 1:** Double slit arrangement.

## Part A Description of change

What change occurred when slit Q was covered with a very thin plate of glass as shown, compared to the situation before with no glass?

- The separation of the fringes decreased in the region OY but was unchanged in the region OX
- The fringe pattern moved towards Y.
- The separation of the fringes decreased.
- The fringe pattern moved towards X.
- The separation of the fringes increased.

## Part B Distance of change

The distance between the double slits and the screen is $L = 50.0\,\text{cm}$, and the slit spacing is $d = 2.00\,\text{mm}$. The glass plate has a refractive index of $n = 1.25$.

If the glass can be considered to be thin enough that any deflection in the trajectory of rays due to refraction can be ignored, how thick must the plate be in order that the distance between O and the central maximum is $5.00\,\text{mm}$

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Adapted with permission from UCLES, A Level Physics, June 1984, Paper 2, Question 13