What does the LED spectrum of the transmission grating look like?

Physics > Light & Optics > Spectrometry & refractometry

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

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Teacher information

Application

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Experiment set-up

What does the LED spectrum of the transmission grating look like?

The wavelength of light can be determined in many different ways.

In this experiment the students learn the so-called objective method with a transmission grating.

The name "transmission grating" means that the light passes through the grating and interferes with it.

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Notes

Since scattered light hardly affects this measurement, the classroom only needs to be slightly darkened so that the interference is visible on the screen. Distances and distances must be measured very accurately, since even small inaccuracies can cause large deviations in the result.

Task

Determine the wavelength of maximum intensity with a transmission grating.

Safety instructions

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The general instructions for safe experimentation in science lessons apply to this experiment.

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Student Information

Motivation

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Experiment set-up

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The wavelength of light can be determined in many different ways.

In this experiment you will learn the so-called objective method with a transmission grating.

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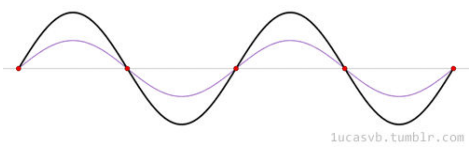

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Equipment

Position	Material	Item No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	2
3	Slide mount without angle scale	09851-02	1
4	Diaphragm holder, attachable	11604-09	2
5	Lens on slide mount, f=+100mm	09820-02	1
6	Screen, semitransparent, 150x150mm²	09851-03	1
7	Lens on slide mount, f=+300mm	09820-04	1
8	Grating, 500 lines/mm, in slide frame, glassless	09851-16	1
9	LED - red, with series resistor and 4 mm plugs	09852-20	1
10	Stray light tube for LED, Di = 8 mm, l = 40 mm	09852-01	1
11	Measuring tape, l = 2 m	09936-00	1
12	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
13	Connecting cord, 32 A, 750 mm, red	07362-01	1
14	Connecting cord, 32 A, 750 mm, blue	07362-04	1

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Set-up (1/2)

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- Connect the stray light tube to the LED according to the illustrations.
- Place the components on the stand material.
- The illumination gap and the grid are not yet needed.




Set-up (2/2)

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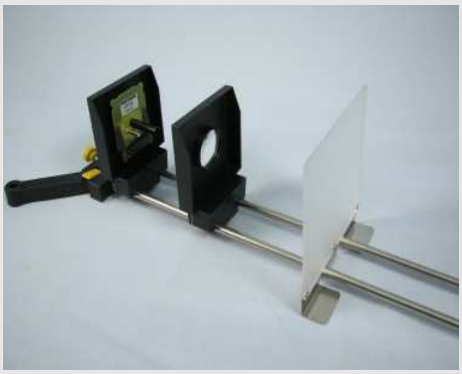
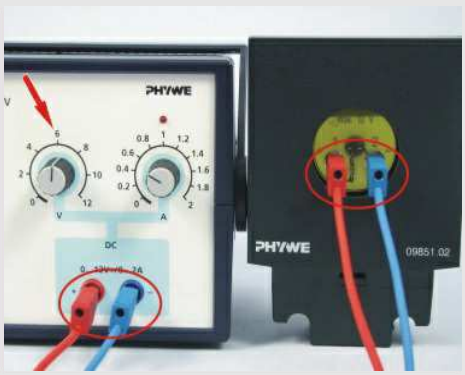
- The LED is connected to the power supply unit (make sure the polarity is correct).
- The power supply unit is set to 6 V.

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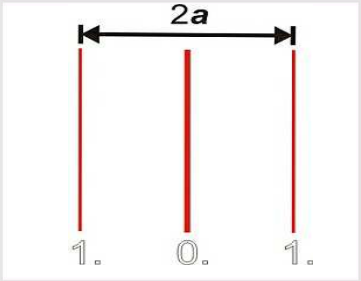
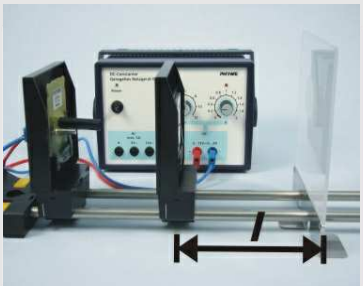
Procedure (1/2)

- The lens is moved back and forth on the tripod material.
- As long as a sharp (and small) light spot can be seen up to the screen.
- The illumination gap and the grating are placed together in an aperture holder on the rider with the lens facing the screen.

Procedure (2/2)





- An interference image is now visible on the screen.
- Measure the distance between the first two maxima.
- Note this as $2 * a$
- Measure the distance between the grid and the screen.
- Note this as l.

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Report

Task 1

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Note down the measured values

for a and l.

$a =$ cm

The grating has 500 lines per mm and the wavelength is 632nm

Combine both equations (right) and solve them according to λat

$\lambda =$ $\cdot$ $arctan($ / $))$

$sin($ a l g

Check

What value do you get for λ?

$\lambda =$

The following equations/formulas are known:

$$sin(\alpha) = \frac{\lambda}{g}$$

$$tan(\alpha) = \frac{a}{l}$$

λ = wavelength of light

g = the grid constant

a = distance to the first interference maximum

l = distance between grille and screen

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Task 2

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Combine both equations (right) and solve them according to λat

By solving the formula $tan(\alpha) = \frac{a}{l}$ to a and inserting it into the formula $sin(\alpha) = \frac{\lambda}{g}$which are looking for l is dissolved, the formula is obtained: $\lambda =$ [ ]. By inserting the values of a, l and g (500 strokes per mm) you get $\lambda =$ [ ] $\times$ [ ] $=$ [ ]. The wavelength of the red LED is specified as 632 nm, which means that there is a deviation of just under [ ] in this measurement.

2% | $sin(arctan(\frac{9.7}{28.5}))$ | $\frac{1m}{500 \cdot 10^3}$ | $g \cdot sin(arctan(\frac{a}{l}))$ | $644 \cdot 10^{-9} m$

Slide	Score / Total
Slide 13: Formula	0/4
Slide 14: Solving the formula	0/5

Total amount 0/9

Solutions | Repeat | Exporting text

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