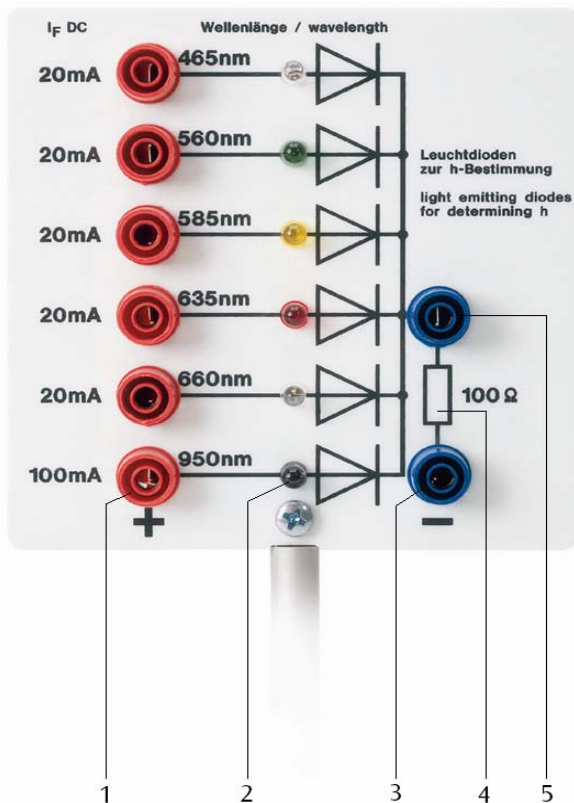# 3B SCIENTIFIC® PHYSICS

Light emitting diodes for determining Planck's constant (*h*) 8482460

Instruction sheet

07/06 SP

1 Sockets for LED's (anode)
2 LEDs, blue to infrared
3 Socket for 100 series resistor
4 Series resistor on (rear of) circuit board 100
5 Socket for common cathode

1. Safety instructions

• When the diodes are brightly illuminated, avoid looking directly at the radiating surface.

• Do not exceed the maximum current.

• Do not operate the diodes without the series resistor.

• Do not allow any liquid to enter the equipment.

2. Description

The equipment is used to determine Planck's constant *h* by measuring the diffusion voltage of multicoloured LEDs as a function of wavelength or frequency. It is also possible to determine wavelengths by means of lattice diffraction, as well as the relation between luminous intensity and current. In addition, the equipment can also be used to determine the current/voltage characteristic curves for the LEDs. The circuit board is equipped with six LEDs in the colours blue, green, yellow, and three different wavelengths of red. The cathodes are lall connected to a common rail. The resistor serves as a protection and should always be connected in series when operating the diodes.

3. Technical data

Operating voltage:	6 V DC
Maximum permissible current:	20 mA, LED (infra-red) 100 mA
Diodes:	6 LEDs (blue, green, yellow, and 3 different wavelengths of red)
Series resistor:	100 Ohm, 1 W
Connections:	4-mm safety connectors
Dimensions:	115 mm x 115 mm
Weight:	120 g approx.

4. Sample experiments

In order to conduct the experiments, the following apparatus is additionally required:

1 DC power supply unit, 0-30 V, stabilised:	8521145
1 Multimeter, Escola 10	8531160
1 Stand base	8611210
Experiment leads	

4.1 Determining Planck's constant (h)

- Connect the diodes individually via the resistance to the voltage source. Make sure they are forward biased.
- Switch on the power supply unit after setting it to the minimum voltage.
- Gradually increase the voltage.

The diodes light up when the bias voltage U_D (between connections 1 and 4) has been reached.

For a wavelength of 950 nm, the light emission can be observed through the viewfinder of a digital camera.

4.2 Evaluation

- Calculate the frequency values from the wavelengths.

  $f = c/\lambda$

- Calculate the values for energy.

  $E = e *10^{-19} \cdot U_D$

- Based on the energy values in the E/f curve, calculate the gradient of the curve.

- Derive the constant (Planck's constant h) from the gradient.

  $e \cdot U_D = h \cdot f$

λ (nm)	Colour	f in 10^{14} Hz $f = c/\lambda$	U_D in V Measurements	$E = e * U_D$ in J*10^{-19} ($e = 1.602*10^{-19}$ As)
465	Blue	6.45	2.26	3.62
560	Green	5.36	1.72	2.76
585	Yellow	5.12	1.67	2.67
635	Light red	4.72	1.51	2.419
660	Dark red	4.54	1.44	2.307
950	Infra-red	3.15	1.0	1.6