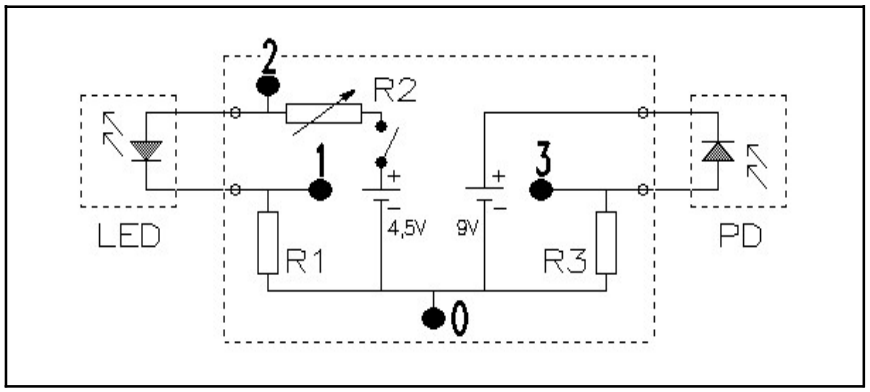

Figure 1.

R_1 = 100 Ω
R_2 = variable resistor
R_3 = 1 MΩ

The points labelled 0, 1, 2 and 3 are measuring points.

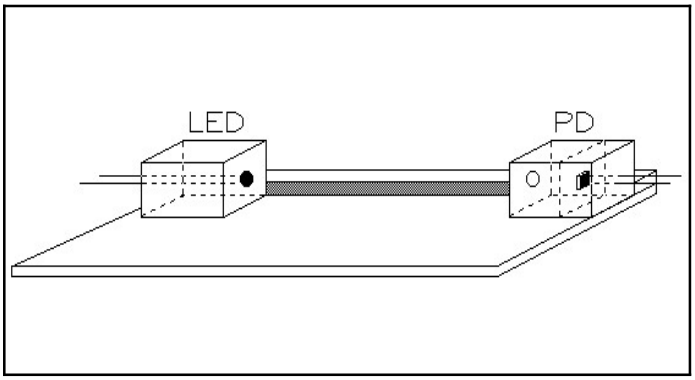

Figure 2 The experimental setup: a board and the two boxes containing the LED and the photo-diode.

Instructions

1. Before we can determine the efficiency of the LED, we must first calibrate the photo-diode. The problem is that we know nothing about the LED.

   Show experimentally that the relation between the current flowing through the photo-diode and the intensity of light falling on it, I [$J.s^{-1}.m^{-2}$], is linear.

2. Determine the current for which the LED has maximal efficiency.

3. Carry out an experiment to measure the maximal (absolute) efficiency of the LED.

No marks (points) will be allocated for an error analysis (in THIS experiment only). Please summarize data in tables and graphs with clear indications of quantities (and units).

Question 5. Determination of the ratio of the magnetic field strengths of two different magnets.

Introduction

When a conductor moves in a magnetic field, currents are induced: these are the so-called eddy currents. As a consequence of the interaction between the magnetic field and the induced currents, the moving conductor suffers a reactive force. Thus an aluminium disk that rotates in the neighbourhood of a stationary magnet experiences a braking force.

Material available

1. A stand.
2. A clamp.
3. An homogenius aluminium disk on an axle, in a holder, that can rotate.
4. Two magnets. The geometry of each is the same (up to 1%); each consists of a clip containing two small magnets of identical magnetization and area, the whole producing a homogenius field, B_1 or B_2.
5. Two weights. One weight has twice the mass (up to 1%) of the other.
6. A stop-watch.
7. A ruler.

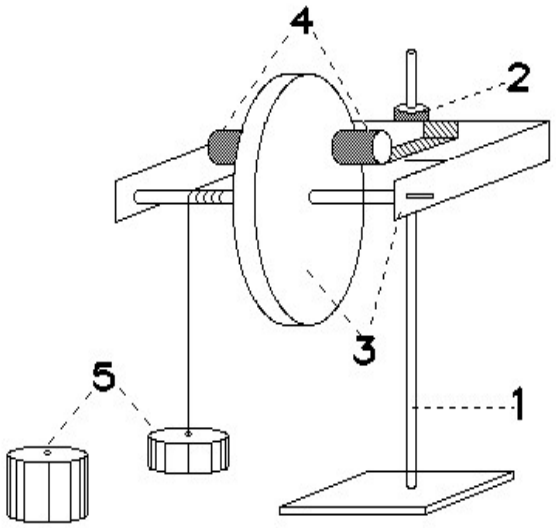

Figure 1.

The experiment

The aluminium disk is fixed to an axle, around which a cord is wrapped. A weight hangs from the cord; and when the weight is released, the disk accelerates until a constant angular velocity is reached. The terminal speed depends, among other things, on the magnitude of the magnetic field strength of the magnet.
Two magnets of different field strengths B_1 or B_2, are available. Either can be fitted on to the holder that carries the aluminium disk: they may be interchanged.

Instructions

1. Think of an experiment in which the ratio of the magnetic field strengths B_1 and B_2, of the two magnets can be measured as accurately as possible.

2. Give a - short - theoretical treatment, indicating how one can obtain the ratio from the measurements.

3. Carry out the experiment and determine the ratio.

4. GIVE AN ERROR ESTIMATION.

Use of the stopwatch

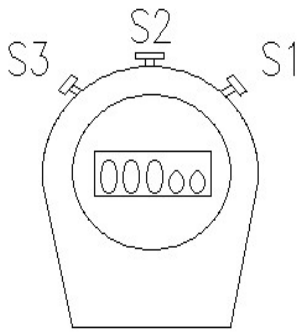

Figure 2.

The stop-watch has three buttons: S_1, S_2 and S_3 (see Fig. 2).

Button S_2 toggles between the date-time and the stop-watch modes. Switch to the stop-watch mode. One should see this:

OOOoo

On pressing S_1 once, the stop-watch begins timing. To stop it, press S_1 a second time.

The stop-watch can be reset to zero by pressing S_3 once.