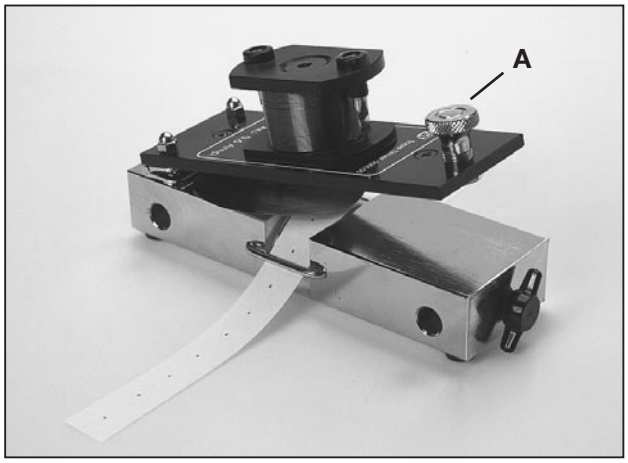
Ticker Tape Timer, no. 2005.00

13.12.10 Ae 2005.00



Description
The timer is designed for the measurement of linear motion. An electromagnet acts on a pin which vibrates and makes marks on a timer tape every 0.01 seconds (100 per second).

The timer is supplied with 4 mm diameter safety jack connections for connection to a power supply. 10 mm diameter holes with wing screws are provided for securing the timer to a laboratory stand.

Required accessories
- Carbon paper, circular, 64 mm diameter (order no. 2005.30)
- Timer tape, width 17.5 mm (order no. 2005.20)
- AC Power Supply which can supply 6 VAC - 0.6 A, for example 3210.50
- Test leads, 2 ea.

Mounting of the timer tape and carbon paper
The timer is opened by tipping up the upper portion as shown in the figure. It is hinged at one end and held in place at the other by means of a magnet. The timer tape is fed through the slot in the bottom plate. It is also advisable to lead the tape through the guides on both sides of the timer as shown. The carbon paper is mounted on a small pin sticking up from the bottom plate, the timer is closed, and the experiment can proceed. It is recommended that the carbon paper be removed after use.

Maintenance
The timer does not require any special maintenance, but it is recommended that it be cleaned occasionally. If the timer does not make clearly legible dots, it is usually due to one of two causes:
The carbon paper is worn out; put in a fresh piece.
The distance between the electromagnet and the marking pin is too great. It should be adjusted as follows:
The top plate position can be adjusted by means of the knurled knob (marked “A” on the figure). Remember to tighten the counter-nut on the underside of the top plate. The position of the marking pin can be adjusted by means of a screwdriver from the bottom of the timer. During adjustment be sure that the timer tape can still pass without resistance through the timer.

Spare parts
Carbon paper, order no.: 2005.30.
Timer tape, order no.: 2005.20.
Wing screw, order no.: 97880240.

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Timer no. 2005.00

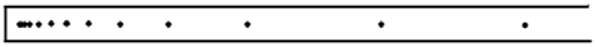
Experiment 1
Determination of the acceleration of gravity

Purpose:
The goal is to find a value for the acceleration of gravity.

Equipment:
Timer, 2005.20
Timer tape, 2005.20
Carbon paper, 2005.50
Weight, 1 kg: 2005.40 / weight 0.5 kg: 2005.50
weight, 0.25 kg: 2005.60

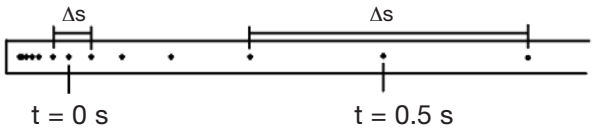
Procedure:
Let a weight pull a timer tape through a timer which can make a mark on the tape every 1/100 of a second. Mount the timer securely at a height of about 2 meters over the floor. Place the timer tape in the timer being careful to allow the tape to pass on the correct side of the carbon paper. Next attach the weight to the timer tape. The timer tape should be about 10 cm shorter than the fall height.

Analysis:
The first portion of the timer tape could look as follows after a typical experiment.



It is apparent that the distance between the marks increases as the speed of the falling weight increases.

For each fifth mark, the speed of the weight is calculated from the formula: $v = \Delta s/\Delta t$
Δs is measured as illustrated on the figure:



Enter the data in a table such as the following:

t:	0 s	0.05 s	0.1 s	0.15 s	0.2 s	0.25 s	0.3 s
Δs:							
$v = \Delta s$ /0.02s:							

By plotting a graph of the speed v vs. the time t in a coordinate system, the acceleration of gravity can be found by determining the slope of the best straight line through the data set.

Supplementary experiment
The same measurement principle can be used for many other experiments involving accelerating bodies, e.g. the motion of a roller skate cart (1929.00) on an inclined plane (1938.00).

Timer no. 2005.00

Experiment 2:
Conservation of mechanical energy during a free fall

Purpose:

In this exercise the conservation of mechanical energy during a free fall is studied. The mechanical energy is the sum of the potential energy and the kinetic energy, i.e.: $E_{mek} = E_{pot} + E_{kin}$

Equipment:

Timer, 2005.20
Timer tape, 2005.20
Carbon paper, 2005.50
Weight, 1 kg: 2005.40 / weight 0.5 kg: 2005.50
weight, 0.25 kg: 2005.60

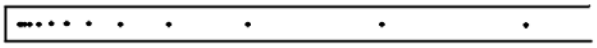
Procedure:

Let a weight pull a timer tape through a timer. The timer can place a mark on the tape every 1/100 of a second. Mount the timer securely at a height of about 2 meters over the floor. Place the timer tape in the timer being careful to allow the tape to pass on the correct side of the carbon paper. Next attach the weight to the timer tape. The timer tape should be about 10 cm shorter than the fall height.

By selecting a number of marks (about 20) on the timer tape, one can find for each mark both how far the weight has fallen from the initial position as well as the speed of the weight at the moment in question.

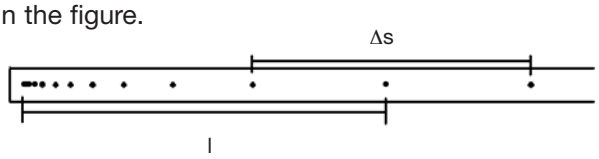
Analysis:

The first portion of the timer tape could look as follows after a typical experiment.



It is apparent that the distance between the marks increases as the speed of the falling weight increases.

For each of the selected points on the tape two distances l and Δs should be measured as illustrated in the figure.



In order to determine the speed of the weight at a particular point one can use the fundamental definition of speed: $v = \Delta s/\Delta t$, where Δs is the distance which the weight has traveled in the time interval Δt. For a given mark on the tape using the distance from the previous mark to the following mark corresponds to a time interval of 0.02 seconds. The speed is thus given by $v = \Delta s/0.02$ s.

For each of the selected marks on the timer tape the potential energy E_{pot} and the kinetic energy E_{kin} can be determined. The potential energy can be set equal to zero at the initial position of the the weight. Thus the potential energy will be negative during the fall, and the sum of the potential and the kinetic energy should remain close to zero.

l	Δs	$E_{pot} = -m \cdot g \cdot l$	$E_{kin} = 0{,}5 \cdot m \cdot v^2$	$E_{mek} = E_{kin} + E_{pot}$

In a successful experiment the total mechanical energy should be equal to zero during the fall of the weight.

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