**SUMMARY**

In the case of uniform acceleration, the instantaneous velocity increases as the distance covered becomes greater. The constant of proportionality between the square of the velocity and the distance covered can be used to calculate the acceleration. This will be investigated in an experiment involving a carriage rolling along a track. In order to measure the instantaneous velocity, an interrupter flag of known width attached to the wagon breaks the beam of a photoelectric sensor. The time for which the beam is broken is then measured by means of a digital counter.

**BASIC PRINCIPLES**

In the case of uniform acceleration, the velocity \( v \) and the distance covered \( s \) increase over the course of time \( t \). Thus the velocity increases as the distance becomes greater.

The instantaneous velocity after a period of time \( t \) is as follows:

\[
(1) \quad v(t) = at
\]

The distance covered is given by

\[
(2) \quad s(t) = \frac{1}{2} at^2
\]

This leads to the following conclusions:

\[
(3) \quad v(s) = \sqrt{2as} \quad \text{and} \quad
\]

\[
(4) \quad v^2(s) = 2as
\]

The instantaneous velocity is given by the following:

\[
(5) \quad v = \frac{\Delta s}{\Delta t}
\]

In order to measure the instantaneous velocity in this experiment, an interrupter flag of known width \( \Delta s \) is attached to the carriage and breaks the beam of a photoelectric sensor as the carriage passes by it. The time the beam is broken \( \Delta t \) is measured by means of a digital counter.

**EVALUATION**

Plotting the squares of the instantaneous acceleration for each run, calculated from the times for which the beam is broken, against the distances covered, it is to be expected that there would be a linear relationship in the case of uniform acceleration as described by Equation 4. The gradient of the straight line through the origin plotted is equal to twice the acceleration.

**REQUIRED APPARATUS**

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<th>Quantity</th>
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