A feature of this instrument is that it has very small zero-drift over prolonged periods of time, better than \( \pm 2 \text{ mtorr h}^{-1} \). Also the change in zero following a large pressure change on one side of the bellows (say 760 torr) is less than 2 mtorr. Short term thermal stability is improved by use of a large heat sink, while mechanical stability is attained by arranging that the bellows are supported so that they hang open under their own weight. The present manometer covers the pressure range 0.1-760 torr and can detect a pressure change equal to that of previous instruments. Full scale deflection on the meter corresponds to a pressure difference across the bellows of 20 mtorr, giving a minimum accuracy to \( \pm 5 \text{ mtorr} \).

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References

A graphical method of integration

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Abstract. A graphical method for the integration of functions with a large range of the independent variable is described.

It sometimes happens that the required particular integral of function cannot be obtained by analytical means and that the straightforward method of graphical integration using a planimeter is not practical because of a very large range of interest of the independent variable. An example of such a function is the one that gives the number of secondary electrons of a particular energy produced in matter as a primary charged particle slows down from an energy of several mega electron volts to a few tens of electron volts.

The method of overcoming this difficulty consists of multiplying every calculated value of the dependent variable by the corresponding value of the independent variable and then plotting the values of this new function on a linear scale against the corresponding values of the original independent variable on a logarithmic scale using log-linear graph paper. The area under this new curve, between the appropriate limits, measured with a planimeter and multiplied by the correct scaling factors, will then give the required integral.

The proof of this is as follows. Let the required integral be

\[ I_1 = \int_{x_1}^{x_2} y(x) dx \]

and the new integral

\[ I_2 = \int_{\ln x_1}^{\ln x_2} f(x) e^x dx \]

where \( y(x) = f(x) \) and where \( \alpha = \ln x \). Therefore \( e^x dx = dx \) and the infinitesimal area \( f(x) e^x dx \) equals the infinitesimal area \( y(x) dx \). As \( I_1 \) and \( I_2 \) are just the limiting values of the sums of these elements of area, the method is proven.

The above method is a particular, and in practice, a very useful case of the more general transformation of the independent variable

\[ \int f(x) dx = \frac{f(x)}{\phi'(x)} d\phi(x) \]

where \( \phi(x) \) is the new independent variable and \( \phi'(x) \) is its first derivative with respect to \( x \). The limits of the integration are, of course, to be adjusted in accordance with this transformation.